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Non-native species monitoring and control in the upper San Juan River, New Mexico 2004

FINAL REPORT



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SAN JUAN RIVER RECOVERY IMPLEMENTATION PROGRAM

Non-native species monitoring and control in the upper
San Juan River, New Mexico
2004

FINAL REPORT

prepared by:

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submitted to:

San Juan River Recovery Implementation Program
Biology Committee

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EXECUTIVE SUMMARY

Intensive non-native removal in 2004 on the upper San Juan River marked the fourth year of such efforts. A total of 6,925 channel catfish *Ictalurus punctatus* and 1,216 common carp *Cyprinus carpio* were removed from RM's 166.6 – 147.9 during 10 removal trips. Of the 10 trips, 6 were conducted from PNM Weir to Hogback Diversion (RM's 166.6 – 159.0) and four from Hogback Diversion to Shiprock Bridge, New Mexico (RM's 158.8 – 147.9). In addition to intensive removal efforts, opportunistic removal during riverwide monitoring trips continued in 2004.

PNM Weir to Hogback Diversion - SECTION 1

Channel catfish CPUE (fish/hour of electrofishing) varied among trip by trip comparisons with the highest CPUE occurring during June-August sampling trips. Among year comparisons revealed no apparent reduction in CPUE (all life stages combined), 2001-2004. However, there were continued reductions in adult CPUE and associated increases in juvenile ($p < 0.001$) CPUE. Channel catfish mean total length (mm) continued to decline since 1999 ($p < 0.001$). Juvenile channel catfish comprised $< 1\%$ of total catch in 1999 and $> 45\%$ in 2004 while channel catfish > 500 mm comprised 52.6% of the catch in 1999 compared to 3.5% in 2004. Common carp CPUE declined ($p < 0.001$) from 2001-2004 to a four year low CPUE of 5.07 fish/hour. There has been no apparent reduction in mean TL of common carp with adult fish still comprising over 90% of the catch.

Largemouth bass *Micropterus salmoides* were collected in this Section in 2004. The six trip CPUE of 3.69 fish/hour was the highest observed among 2001-2004 comparisons. Prior to 2004, collections of largemouth bass were incidental with CPUE < 0.3 fish/hour. The largest collection in 2004 occurred during the 17-19 August trip with 14.7 fish/hour collected. All largemouth bass collected ranged from 40 – 187 mm TL.

Hogback Diversion to Shiprock Bridge - SECTION 2

Similar to efforts upstream, channel catfish CPUE varied seasonally within this reach. Catch rates for all size classes combined did not decline between 2003-2004. Adult CPUE decreased ($p < 0.001$) from 46.4 to 27.1 fish/hour, 2003-2004, while juvenile CPUE increased ($p < 0.001$). Mean total length of channel catfish decreased between years (2003 Mean TL = 386.4 mm; 2004 Mean TL = 333.2). Common carp CPUE declined ($p < 0.001$) from 29.3 fish/hour in 2003 to 9.1 fish/hour in 2004. No apparent declines in mean TL of common carp were observed. Catch rates for channel catfish were higher ($p = 0.003$) within this Section compared to CPUE in the PNM Weir to Hogback Diversion Section.

Riverwide Removal

Decreasing trends in riverwide non-native CPUE continued in 2004 with both channel catfish and common carp CPUE at the second lowest levels observed among 1998-2004 comparisons. Adult channel catfish CPUE was at the lowest levels observed during riverwide monitoring among 1998-2004 comparisons. Juvenile channel catfish CPUE increased in 2004 ($p < 0.001$) but were still at levels lower than 2001, when intensive removal began. Large adult channel catfish continued to comprise less of the total channel catfish catch in 2004. Mean TL of channel catfish declined in 2004 and represented the smallest mean TL among 1998-2004 comparisons ($p < 0.001$). Common carp CPUE for all size classes combined was slightly up in 2004 but remained at levels below those observed in 1998. Adult common carp CPUE are at the lowest levels among 1998-2004 comparisons ($p < 0.001$). Declines in common carp are due to reductions in the number of adults removed with juvenile common carp continuing to comprise $< 10\%$ of the catch.

Removal efforts on the San Juan River, intensive and riverwide, has seen encouraging results in the control and monitoring of channel catfish and common carp since 2001. Fewer large, fecund adult channel catfish and continued declines in mean size have presumably reduced reproductive potential of channel catfish. Reductions in riverwide common carp abundance have likely limited negative interactions with native fish while greatly reducing the overall biomass of carp in the San Juan River.

Continued removal efforts may aid recovery actions for both razorback sucker and Colorado pikeminnow in the San Juan River. Augmentation is currently centered in upper portions of the San Juan River where intensive non-native removal occurs. Fewer non-native fish present may give rare fish a competitive edge and reduce overall negative interactions, including predation, resulting in higher retention rates further upstream in the system.

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INTRODUCTION

The presence of non-native fishes within the San Juan River may have deleterious effects on recovery efforts for Colorado pikeminnow *Ptychocheilus lucius* and razorback sucker *Xyrauchen texanus*. Channel catfish *Ictalurus punctatus* and common carp *Cyprinus carpio* may affect native aquatic communities through trophic interactions (direct predation, possible competition for food), spatial interactions (competition for habitat, spawning space or feeding areas), and by habitat alteration (Brooks et al. 2000; Minckley 1991; Sigler 1987; Tyus and Saunders 2000). Of these factors, only direct predation and aggressive behavior/harassment has been documented on the San Juan River (Brooks et al. 2000 and Ryden, personal communication). Opportunistic removal of non-native fishes began in 1996 and was formally adopted as a management tool in 1998. United States Fish and Wildlife Service (FWS), New Mexico Fishery Resources Office (NMFRO) evaluated numerous capture techniques and determined that raft mounted electrofishing was the most efficient method to remove large bodied non-native fish (Brooks and Smith 2005).

Removal efforts by NMFRO officially began in 1998 with intensified efforts beginning in 2001. Efforts focused on a 7.6 mile reach of river located near Fruitland, NM (Figure 1). Determination for location of concentrated removal efforts was influenced by information on adult fish distribution and abundance collected and reported on by FWS – Grand Junction (FWS-GJ) (Ryden 2000). Data suggested that distribution of channel catfish and common carp were limited upstream of PNM Weir (RM 166.6) and that the majority of non-native fishes within Geomorphic Reaches 6 and 5, as described by Bliesner and Lamarra (2000), were considered adult. Presence of water diversion structures that may serve as potential impediments to upstream fish movement and the propensity of large adult non-native fishes determined where intensive removal efforts would take place.

Efforts in 2004 marked the fourth consecutive year of removal from PNM Weir to Hogback Diversion (RM 166.6 - 159.0). Due to seasonal variance in catch rates (CPUE; fish/hour of electrofishing) of non-native fishes, efforts were expanded to include an additional 11.1 river miles immediately downstream. Mark/recapture work conducted by NMFRO documented upstream movement into the study reach by channel catfish and common carp (Davis and Coleman 2004). These movement patterns correspond to the construction of a non-selective fish ladder completed in 2001 at RM 159.0. Hogback fish ladder allows for unobstructed movement by all fish species, including non-natives. In addition to intensive non-native removal trips, opportunistic removal riverwide during sub-adult and adult fish monitoring trips has occurred since 1996.

Study objectives were:

1. Continue data collection and mechanical removal of non-native species during main channel adult rare fish monitoring efforts.
2. Evaluate distribution and abundance patterns of non-native species to determine effects of mechanical removal on abundance and distribution patterns.
3. Continue translocation of channel catfish to fishing impoundments isolated from the San Juan River.
4. Characterize the distribution and abundance of striped bass *Morone saxatilis* upstream of Lake Powell during removal efforts and determine predatory impacts via stomach content analysis.
5. Develop catch per unit effort targets for use in evaluation of mechanical removal in discrete river reaches.

STUDY AREA

Non-native fish were removed from the San Juan River; Colorado, New Mexico, Utah; in all accessible habitats from Farmington, New Mexico (Animas River confluence [RM 180.0]) downstream to Clay Hill's Landing (RM 2.9), Utah (Figure 1).

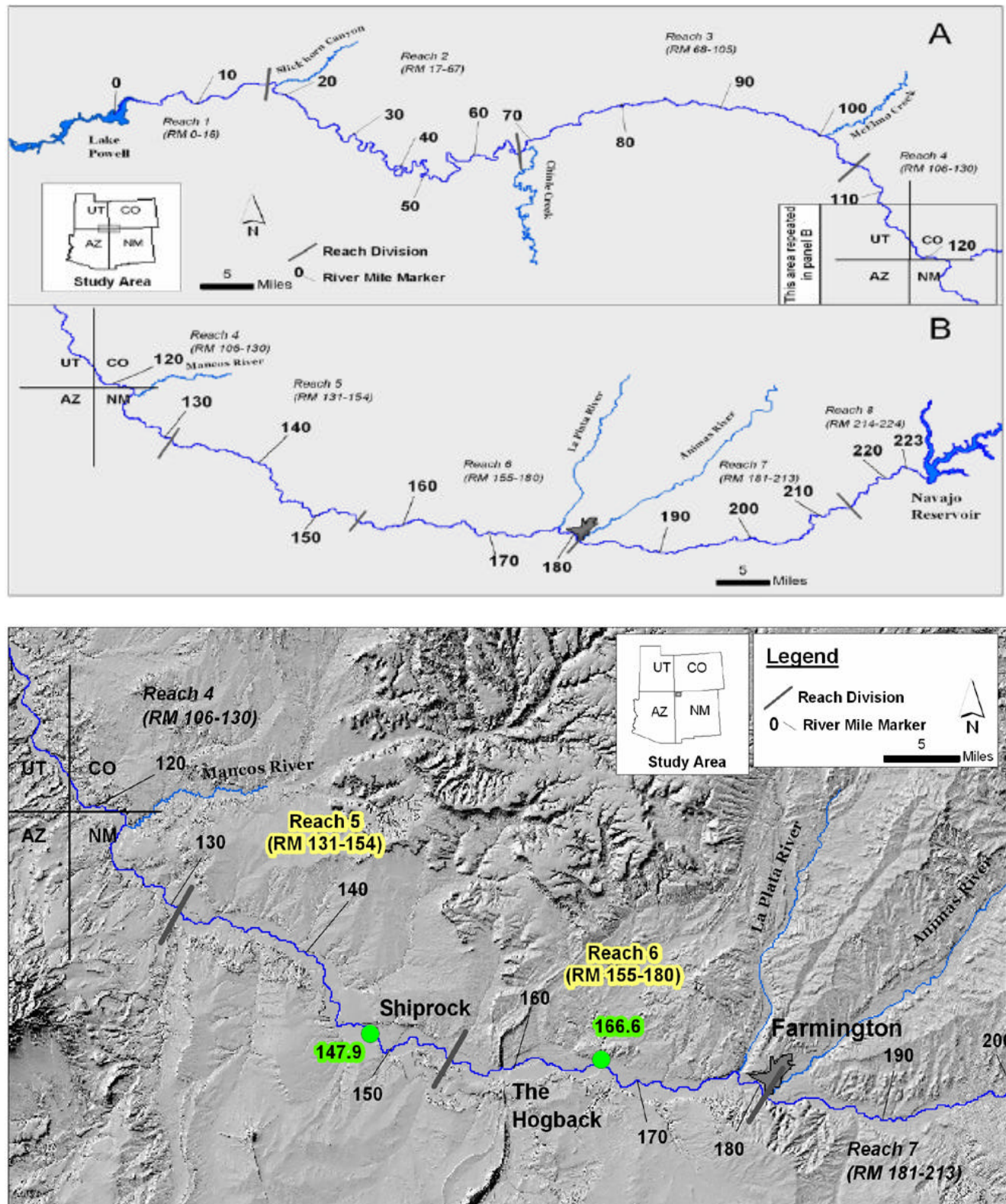


Figure 1. Map of study area including entire San Juan River basin (top) and a more detailed map of intensive removal reaches (green highlights; bottom). –map provided by Sara Gottlieb, UNM MSB

Intensive non-native removal efforts were focused on 18.7 river miles of the San Juan River located in the northwestern portion of New Mexico near the towns of Fruitland and Shiprock (Figure 1.). Two removal Sections were sampled between RM's 166.6 – 147.9 and were located within Geomorphic Reaches 6 and 5. These separate Sections are delineated by a water diversion structure, Hogback Diversion. Throughout this report Section 1 will refer to PNM to Hogback Diversion (RM 166.6 – 159.0) while Section 2 refers to Hogback Diversion to Shiprock Bridge (RM 158.8 – 147.9).

METHODS

Sampling conducted during adult monitoring trips in 2004 followed similar protocols to previous years (Ryden 2000). Fishes were collected using raft mounted electrofishers. Rafts consisted of a rower and a netter and floated near the shoreline netting all fish seen. Sampling was conducted in one RM increments. At the end of each RM, all fish collected were enumerated by species and size class. At the end of every fifth mile, or designated mile, fish were measured to the nearest millimeter (mm) for total and standard lengths and weighed to the nearest 5 grams (g) for mass. All non-native fishes were removed from the river with exception of anchor tagged fish that were returned to the river.

Sampling conducted in Sections 1 and 2 followed similar protocol. In addition, a support raft was used both to collect any non-native fishes that surfaced behind the shocking rafts and to serve as a holding unit for transporting live fish. All non-native fishes or a representative sub-sample were measured (nearest 1 mm) for total and standard lengths and weighed (nearest 5 g) for mass. All non-native fishes were removed from the river. When possible, channel catfish were held for transplantation. Channel catfish were kept in live wells treated with salt and stress coat to alleviate stress caused by holding and transporting. A battery powered aeration system or compressed oxygen was used for circulation and aeration. Channel catfish were transported from the San Juan River in distribution trucks provided by New Mexico Department of Game and Fish and Navajo Nation Department of Fish and Wildlife to closed impoundments located within the drainage.

Analyses of all available capture data were divided between project types and were analyzed independently of each other. Catch rates among years from PNM to Hogback, Hogback to Shiprock and Riverwide sampling were compared independently.

To determine trends in distribution and abundance, CPUE (fish/hour of electrofishing) were calculated using software package SPSS 10.0. Species CPUE represents the total number of fish collected divided by the total effort of sampling (hours of electrofishing). Data were summarized by type of trip (i.e. intensive removal, riverwide), year, reaches and by individual trips. All CPUE data that was not normally distributed were first analyzed using non-parametric Kruskal-Wallis rank tests. If significant differences were observed, among year comparisons were conducted using a Mann-Whitney U test or Dunnett T3 pairwise comparisons to obtain p-values.

Length (total length in millimeters) was used to determine changes in size class distributions of non-native fishes. When length data were normally distributed a one-way ANOVA was performed on unranked data to determine significant differences among years.

RESULTS

PNM Weir to Hogback Diversion (RM 166.6 – 159.0) – SECTION 1

A total of 2,902 channel catfish and 461 common carp were collected during six trips and 84.50 hours of electrofishing (Tables 1). Of these fish, 26 channel catfish and 31 common carp were anchor tagged recaptures and were released back to the river. The remaining fish were removed from the river. In addition to channel catfish and common carp, other non-native fishes removed from Section 1 included rainbow trout *Oncorhynchus mykiss*, brown trout *Salmo trutta*, bullhead catfishes *Ameiurus spp.*, largemouth bass *Micropterus salmoides*, green sunfish *Lepomis cyanellus*, bluegill *Lepomis macrochirus*, and white sucker *Catostomus commersoni*. No striped bass *Morone saxatilis* were collected or observed.

Table 1. Total count of major species collected during intensive non-native removal efforts from PNM Weir to Hogback Diversion, 2004.

| Trip | <i>Ptyluc</i> | <i>Xyrtex</i> | <i>Ictpun</i> | <i>Cypcar</i> | <i>Micsal</i> | <i>Ameiurus</i> <i>spp</i> | <i>Saltru</i> |
|----------------------|---------------|---------------|---------------|---------------|---------------|-------------------------------|---------------|
| 23-24 March | 0 | 2 | 15 | 52 | 0 | 1 | 4 |
| 20-22 April | 4 | 2 | 116 | 68 | 2 | 4 | 18 |
| 29 June – 01 July | 8 | 9 | 854 | 95 | 4 | 3 | 9 |
| 20-22 July | 5 | 3 | 1,082 | 54 | 46 | 16 | 3 |
| 17-19 August | 5 | 3 | 831 | 104 | 269 | 8 | 3 |
| 8 November | 5 | 2 | 4 | 88 | 4 | 0 | 7 |
| Totals | 27 | 21 | 2,902 | 461 | 325 | 32 | 44 |

Six trips were conducted from March to November (Table 1). Channel catfish CPUE was low initially ranging from 1.3 to 6.1 fish/hour of electrofishing. Trips conducted during June, July and August had increased CPUE ranging from 38.6 to 51.5 fish/hour (Figure 2). Channel catfish CPUE for all trips and all size classes combined was 28.8 fish/hour with the majority of fish collected during summer sampling (Table 1; Figure 2).

During the first two sampling trips, most channel catfish collected were adult fish with a juvenile CPUE of 0.0 and 0.2, respectively. During summer sampling, CPUE for both juvenile and adult channel catfish were nearly identical and ranged from 18.2 to 26.2 fish/hour (Figure 2).

Channel catfish CPUE among years has not declined since intensive non-native removal began in 2001 (Figure 3). Shifts in CPUE by size class has been observed with fewer, although not significantly, adult fish collected from 2003-2004. Juvenile CPUE did not change between 2003-2004 but remain higher ($p < 0.001$) than values observed 2001-2002.

Shifts towards smaller sized channel catfish has been documented since 1999 and this trend continued in 2004. Mean total length (TL) in 2004 was 334.5 mm compared to 487.1 in 1999. Juvenile channel catfish (< 300 mm TL) comprised 47.7% of the catch in 2004 and were absent from collections in 1999. In addition, large channel catfish > 500 mm TL comprised 52.6% of the catch in 1999 compared to 3.5 % in 2004 (Figure 4). Four individual catfish > 600 mm were collected in 2004.

Common carp CPUE in 2004 varied little with the majority of trips having rates < 10 fish/hour (Figure 5). Only the 8 November trip had CPUE > 10 fish/hour. Similar to previous years, majority ($> 90\%$) of common carp removed in 2004 were adult fish with a mean TL of 485.8 mm.

Unlike channel catfish, common carp CPUE since 2001 significantly declined ($p < 0.001$) within this Section. Declines in CPUE has been observed with each subsequent year of removal, with a mean CPUE of 5.1 fish/hour in 2004, compared to 18.5 fish/hour in 2001 (Figure 5). Highest trip CPUE (14.7 fish/hour) in 2004 was lower than 60% of trips conducted in 2001.

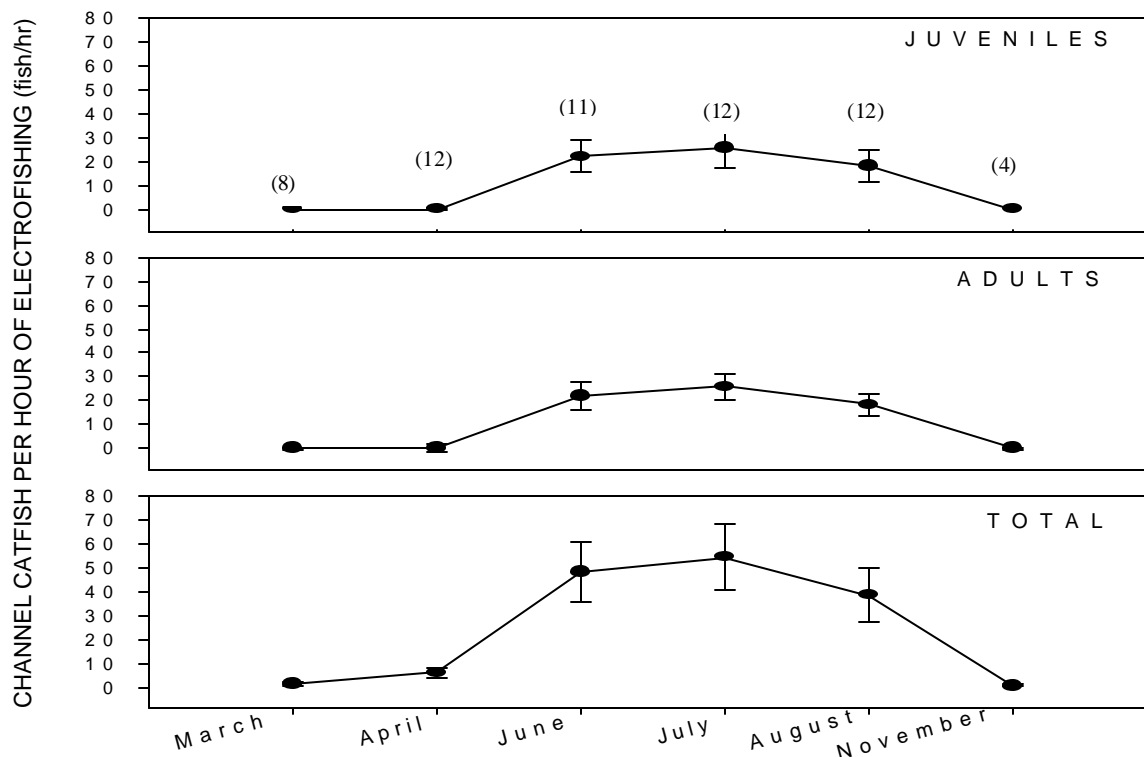


Figure 2. Channel catfish CPUE (fish/hour) by trip within the PNM Weir to Hogback Diversion Section. Sample size listed parenthetically and error bars represent ± 1 SE.

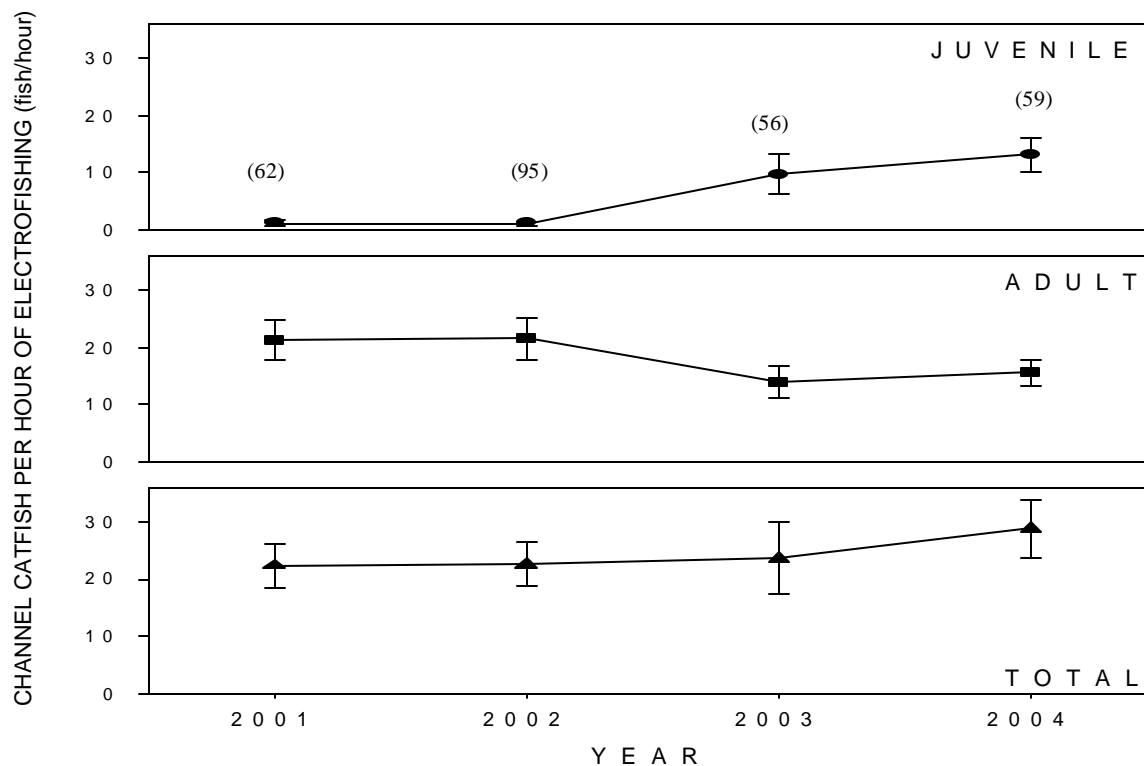


Figure 3. Channel catfish CPUE (fish/hour) by year within the PNM Weir to Hogback Diversion Section. Sample size listed parenthetically and error bars represent ± 1 SE.

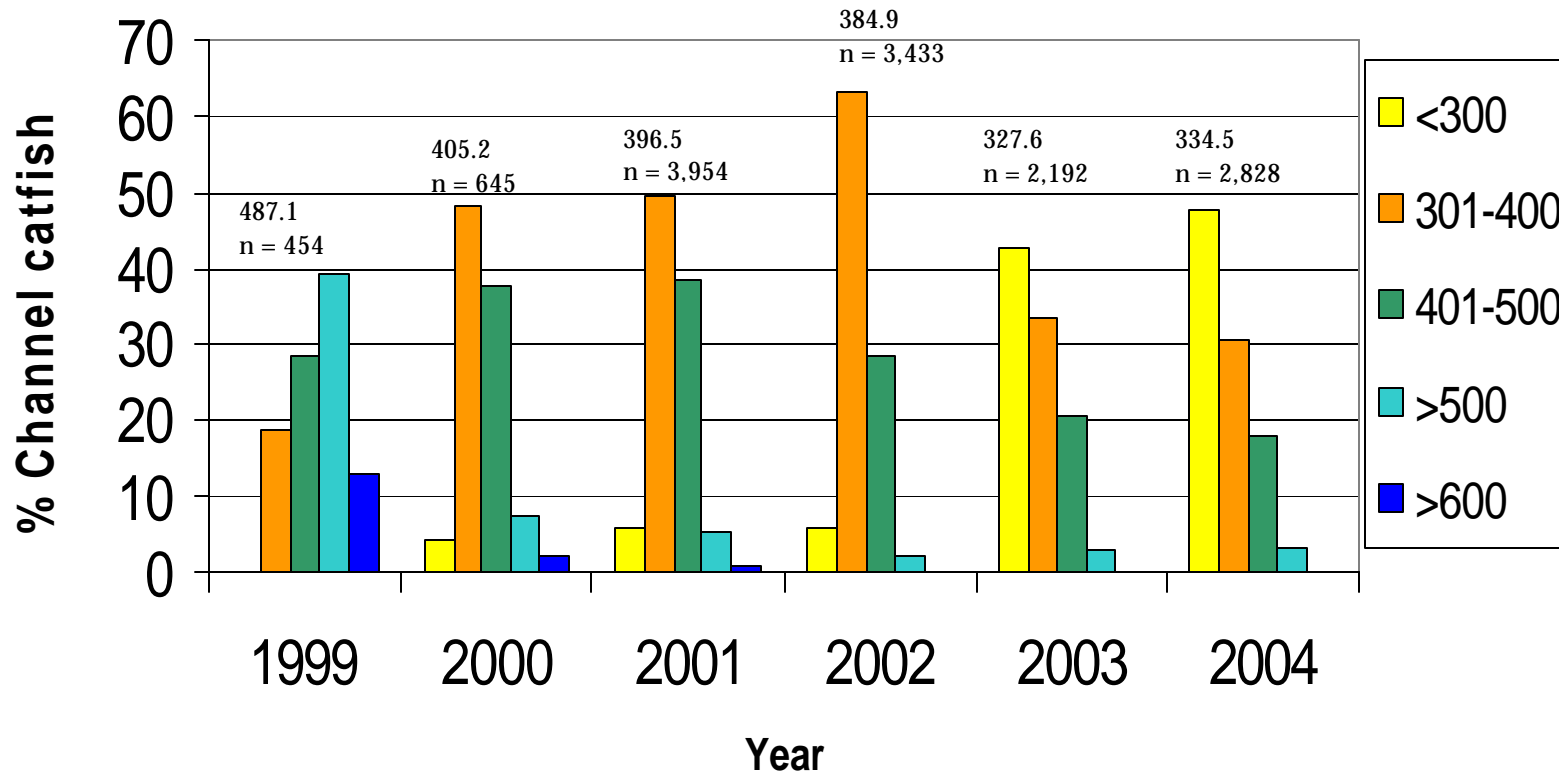


Figure 4. Size class distribution of channel catfish collected from PNM Weir to Hogback Diversion, 1999 – 2004. Mean total length (mm) and sample size above bars.

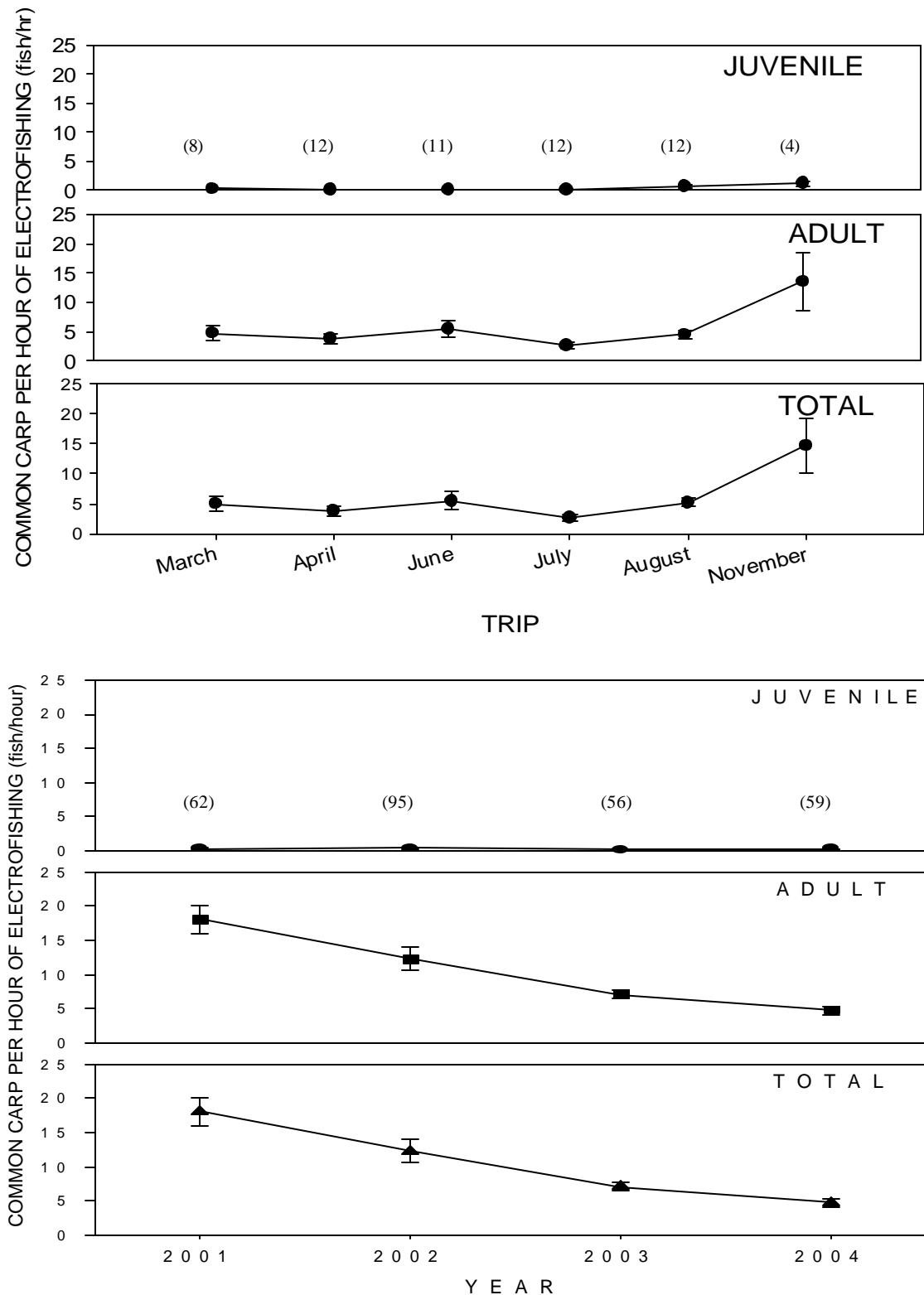


Figure 5. Common carp CPUE (fish/hour) by trip in 2004 (top) and by year (bottom); PNM Weir to Hogback Diversion. Sample size listed parenthetically and error bars represent ± 1 SE.

At RM 163.7, a rock and concrete weir operated by Arizona Public Service (APS) separates this intensive non-native removal Section into sub-sections. Channel catfish and common carp CPUE varied between sub-sections. A total of 309 channel catfish and 95 common carp (12.01% of catch) were collected upstream of APS Weir, while 2,593 and 366 (87.99%), respectively, were collected downstream. Differences in CPUE for both species between sub-sections has been evident since 2001. Channel catfish CPUE in 2001 was nearly identical between sub-sections (22.3 and 22.5 fish/hour). However, channel catfish CPUE was significantly lower ($p < 0.001$) upstream of APS Weir in 2004 with 8.7 fish/hour compared to 48.2 fish/hour downstream (Figure 6). Similar trends were observed for common carp with a 2004 CPUE of 2.7 fish/hour upstream of APS and 7.3 fish/hour below, $p < 0.001$ (Figure 6). These data demonstrate that APS Weir, under recent flow discharge conditions, has served as a partial impediment to upstream movement of non-native fishes.

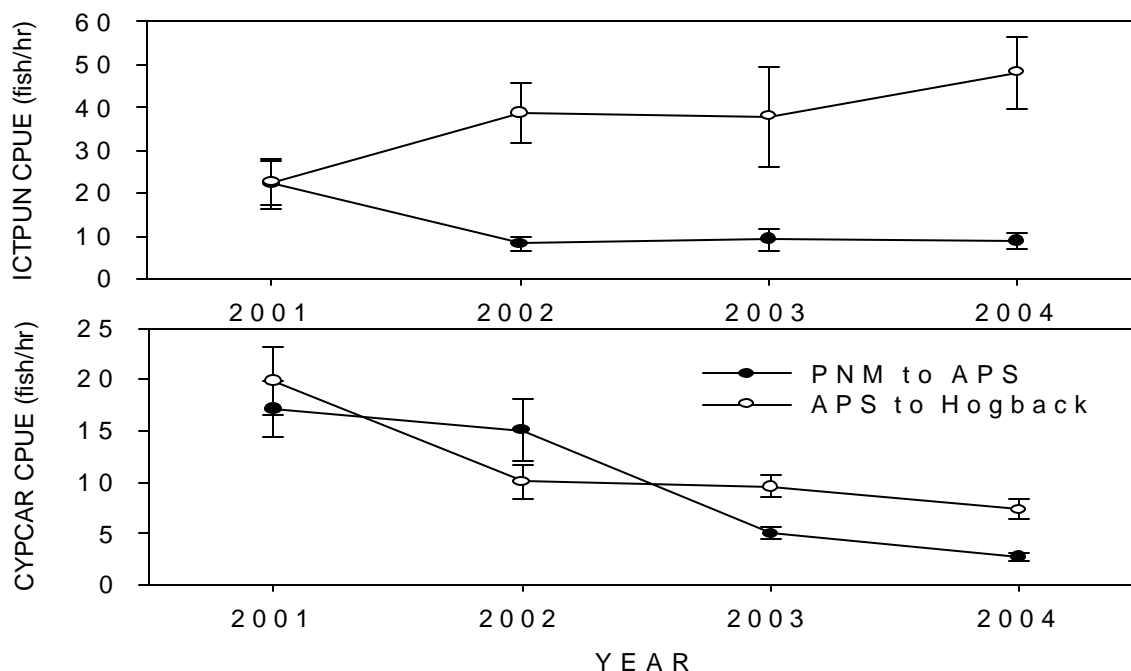


Figure 6. Comparison of channel catfish (ICTPUN) and common carp (CYPCAR) CPUE (fish/hour) between separate sub-sections of Section 1 (PNM Weir to Hogback Diversion), 2001-2004. Error bars represent ± 1 SE.

Total biomass (kilograms) of channel catfish and common carp removed has declined since 2001. Channel catfish biomass removed declined from 2,569 kg in 2001 to 1,262 kg in 2004. Some of this decline may be due to a reduction in number of trips conducted between years. However, although effort has not remained constant among years, it is important to note declines in overall numbers of fish removed and the amount of kg/channel catfish in 2001-2004 comparisons (Figure 7). Mean condition factor $K_{(f)}$ (Fulton type; $(W/L^3) \times 100,000$) for channel catfish decreased from 0.97 in 2001 to 0.94 in 2004 ($p < 0.001$). Lower numbers of common carp removed have also resulted in less total kilograms removed among 2001-2004 comparisons. The amount of kg/common carp, however, has increased resulting in fewer but larger, more robust common carp (Figure 7). Mean condition factor $K_{(f)}$ for common carp increased from 1.37 in 2001 to 1.74 in 2004 ($p < 0.001$).

Relatively high numbers of largemouth bass were collected in Section 1 in 2004. Trip by trip CPUE ranged from 0.0 fish/hour during late March sampling to 14.7 fish/hour during August

sampling (Figure 8). A six trip mean CPUE of 3.7 fish/hour represents the highest catch rates for largemouth bass among 2001-2004 comparisons ($p = 0.03$). Prior to 2004, highest yearly CPUE was 0.3 fish/hour. Due to difficulties encountered in netting these fish, CPUE effort metrics most likely under estimate largemouth bass abundance in this Section. All largemouth bass collected were juveniles and ranged from 40-187 mm TL.

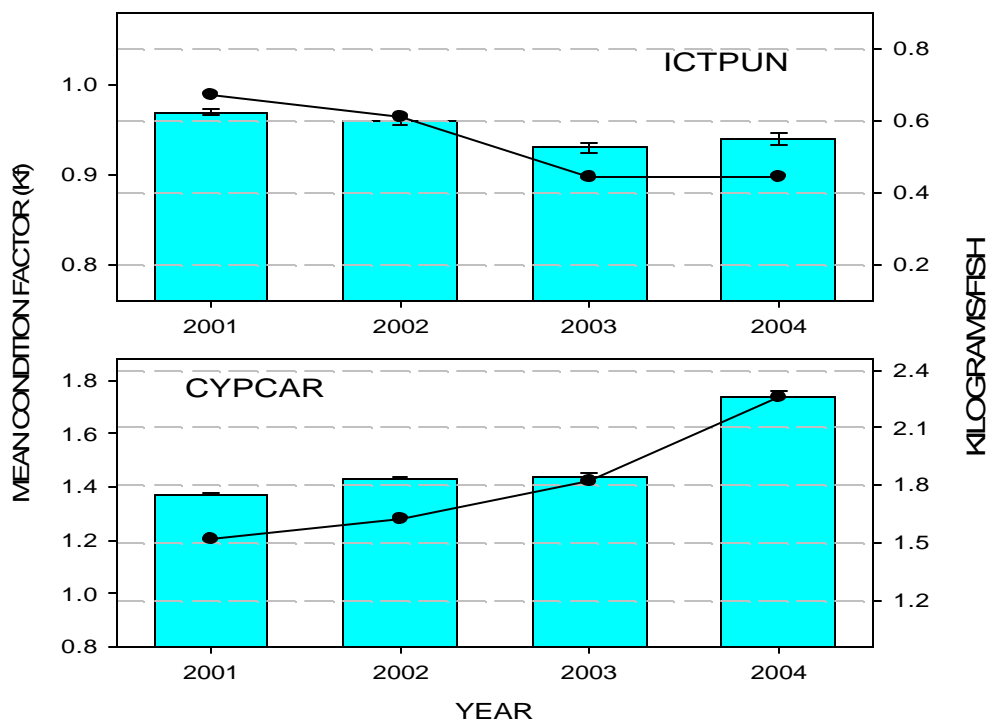


Figure 7. Mean condition factor K_t and kilograms/fish of channel catfish [ICTPUN] and common carp [CYPCAR] collected from PNM Weir to Hogback Diversion, 2001-2004. Bars represent Mean K_t and lines represent kilograms/fish.

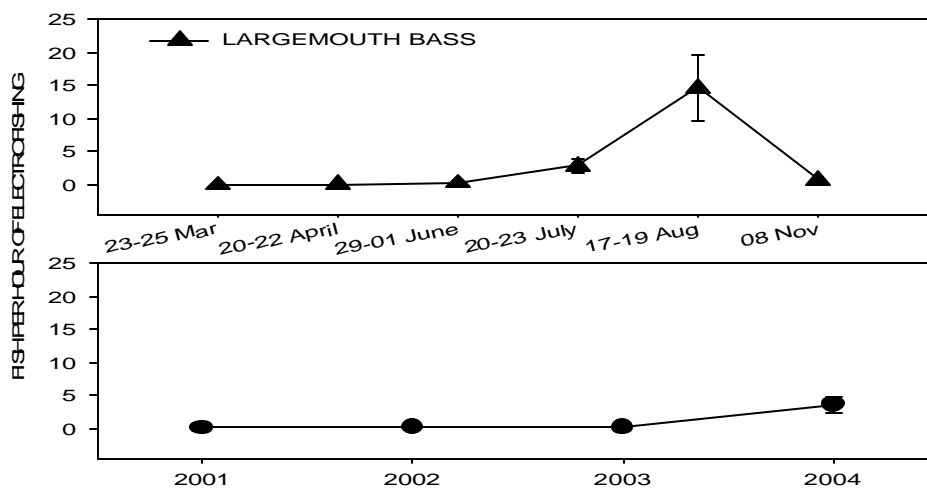


Figure 8. Largemouth bass CPUE (fish/hour of electrofishing) by trip and by year within the PNM Weir to Hogback Diversion Section, 2001-2004. Error bars represent ± 1 SE.

Hogback Diversion to Shiprock Bridge (RM 158.8– 147.9) – SECTION 2

A total of 4,023 channel catfish and 755 common carp were collected within this Section during four trips and 76.6 hours of electrofishing (Table 2). All non-native fishes were removed from this Section. In addition to channel catfish and common carp, other non-native fishes removed from this Section in 2004 include rainbow trout *Oncorhynchus mykiss*, brown trout *Salmo trutta*, bullhead catfishes *Ameiurus spp.*, largemouth bass *Micropterus salmoides*, green sunfish *Lepomis cyanellus*, and white sucker *Catostomus commersoni*. No striped bass *Morone saxatilis* were collected or observed.

Four trips were conducted from May to November (Table 2). Channel catfish CPUE was relatively high and ranged from 25.4 to 98.1 fish/hour. Trips conducted in June and September had overall CPUE > 80 fish/hour comprising 76.06% of the total channel catfish catch for the year (Figure 9). Channel catfish CPUE by size class varied among trips. May adult CPUE was 17.7 fish/hour and 7.8 fish/hour for juvenile fish. June CPUE varied with an adult CPUE of 31.9 and 52.7 fish/hour for juveniles (Figure 9) Adult CPUE in 2004 was 27.1 fish/hour and 29.1 for juveniles.

Table 2. Total count of major species collected during intensive non-native removal efforts from Hogback Diversion to Shiprock Bridge, 2004.

| Trip | <i>Ptyluc</i> | <i>Xyrtex</i> | <i>Ictpun</i> | <i>Cypcar</i> | <i>Micsal</i> | <i>Ameiurus</i> spp | <i>Saltru</i> |
|--------------------|---------------|---------------|---------------|---------------|---------------|------------------------|---------------|
| 11-13 May | 3 | 46 | 497 | 86 | 0 | 4 | 5 |
| 15-17 June | 47 | 28 | 1,791 | 219 | 0 | 3 | 6 |
| 14-15 September | 25 | 71 | 1,269 | 143 | 46 | 2 | 2 |
| 16-18 November | 9 | 58 | 466 | 307 | 1 | 6 | 4 |
| Totals | 84 | 203 | 4,023 | 755 | 47 | 15 | 17 |

Catch rates between years have not changed, 2003-2004, and channel catfish CPUE for all trips and all life stages combined in 2004 was 56.1 fish/hour (Figure 10). Changes in both adult and juvenile fish CPUE was significantly different than 2003 values. Adult CPUE decreased from 46.4 fish/hour ($p < 0.001$) in 2003 while juvenile CPUE increased from 10.9 fish/hour ($p < 0.001$).

Mean total length (TL) in 2004 was 333.23 mm compared to 386.4 mm in 2003 (Figure 11). Juvenile channel catfish (< 300 mm TL) comprised 50.5% of the catch in 2004 compared to 19.2% in 2003, while fish ranging from 401-500 mm comprised over 40.0% of the 2003 catch and < 25.0% in 2004 (Figure 11).

Common carp CPUE was relatively low in 2004. Mean CPUE of all trips in 2004 was < 15 fish/hour with the 8 November trip having the highest CPUE of 12.9 fish/hour (Figure 12). Catch rates by size class varied little with the majority of common carp collected classified as adult fish (> 250 mm). Juvenile CPUE was 0.6 fish/hour and comprised 7.3% of the total common carp catch.

In contrast to channel catfish, common carp CPUE declined from 29.1 fish/hour in 2003 to 9.1 fish/hour in 2004 ($p < 0.001$). Catch rates for juvenile common carp were < 4.0 fish/hour during all trips in 2004 (Figure 13). Significant differences between years are a result of declines ($p < 0.001$) in adult CPUE (Figure 13). No changes in mean TL of common carp occurred between years.

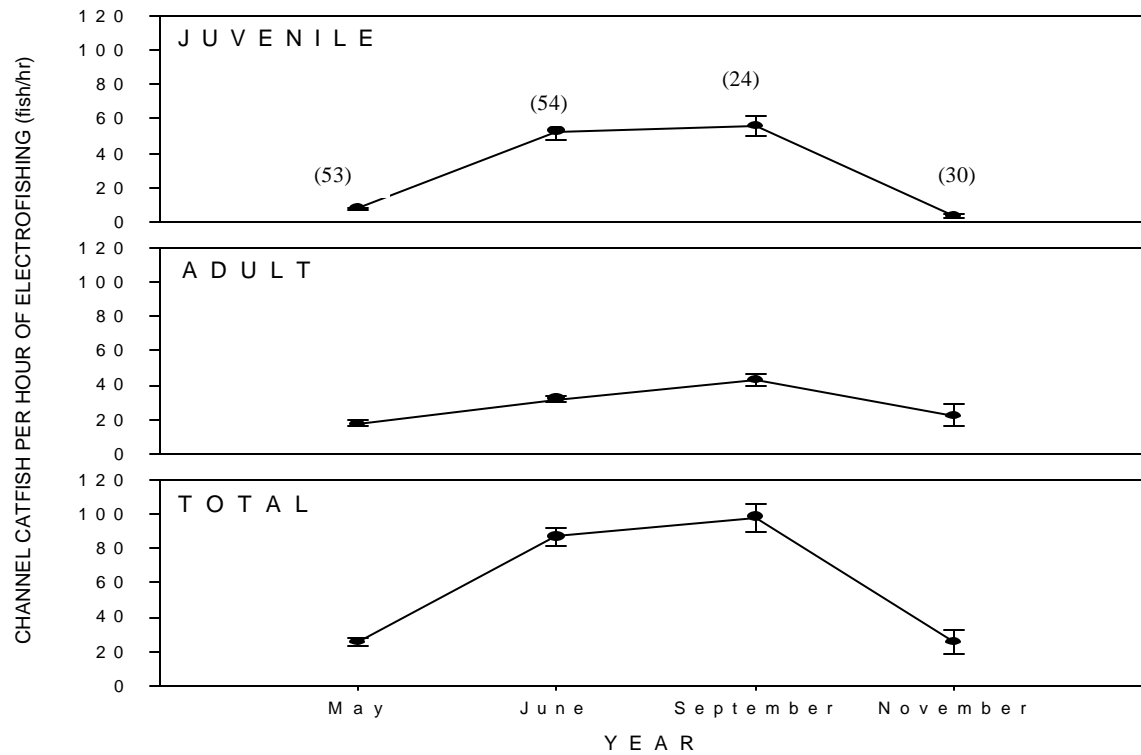


Figure 9. Channel catfish CPUE (fish/hour) by trip within the Hogback Diversion to Shiprock Bridge Section. Sample size listed parenthetically and error bars represent ± 1 SE.

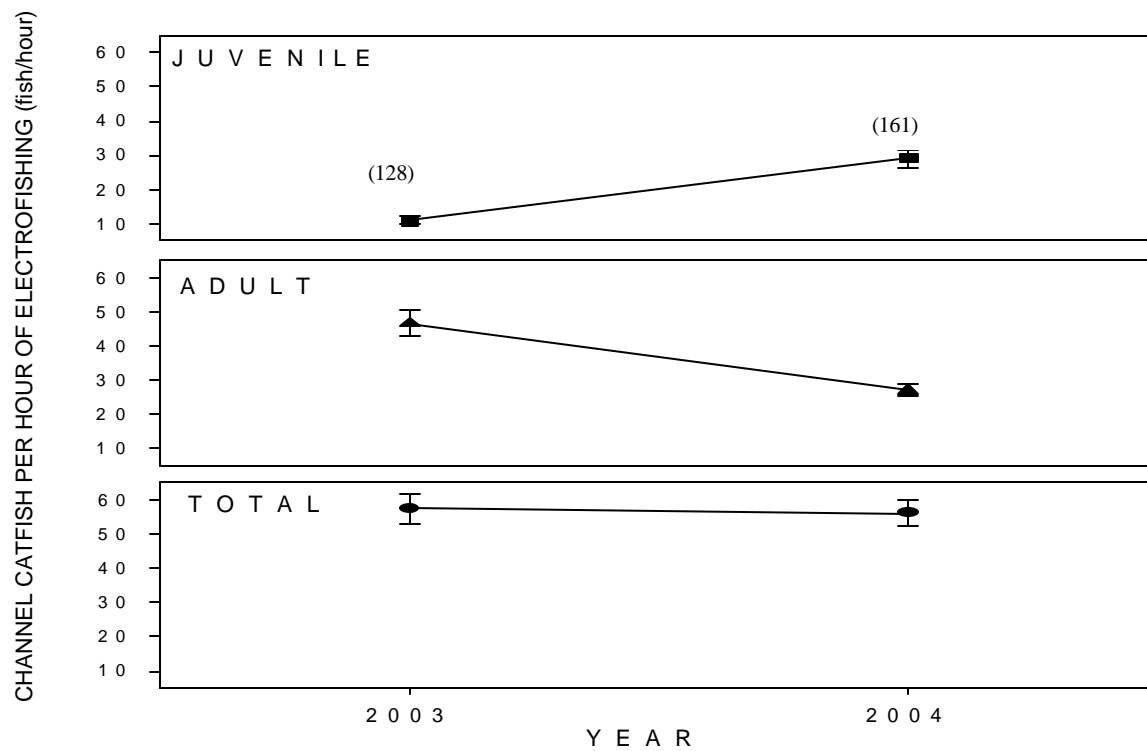


Figure 10. Channel catfish CPUE (fish/hour) by year within the Hogback Diversion to Shiprock Bridge Section. Sample size listed parenthetically and error bars represent ± 1 SE.

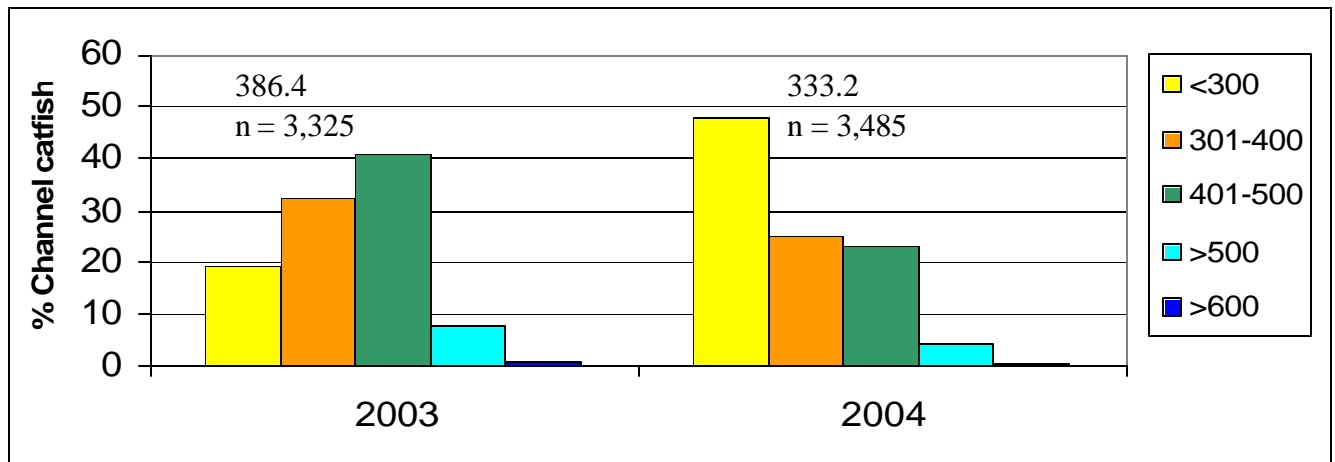


Figure 11. Size class distribution of channel catfish collected within the Hogback Diversion to Shiprock Bridge Section, 2003-2004. Mean total length (mm) and sample size above bars.

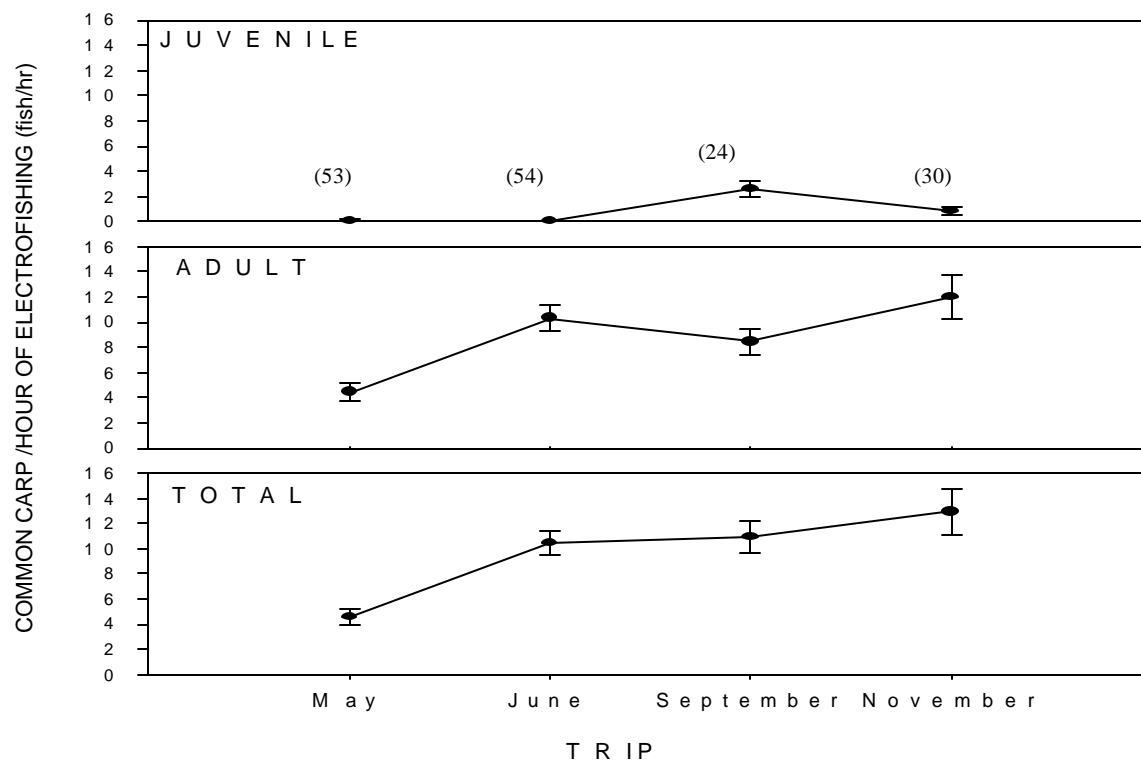


Figure 12. Common carp CPUE (fish/hour) by trip within the Hogback Diversion to Shiprock Bridge Section. Sample size listed parenthetically and error bars represent ± 1 SE.

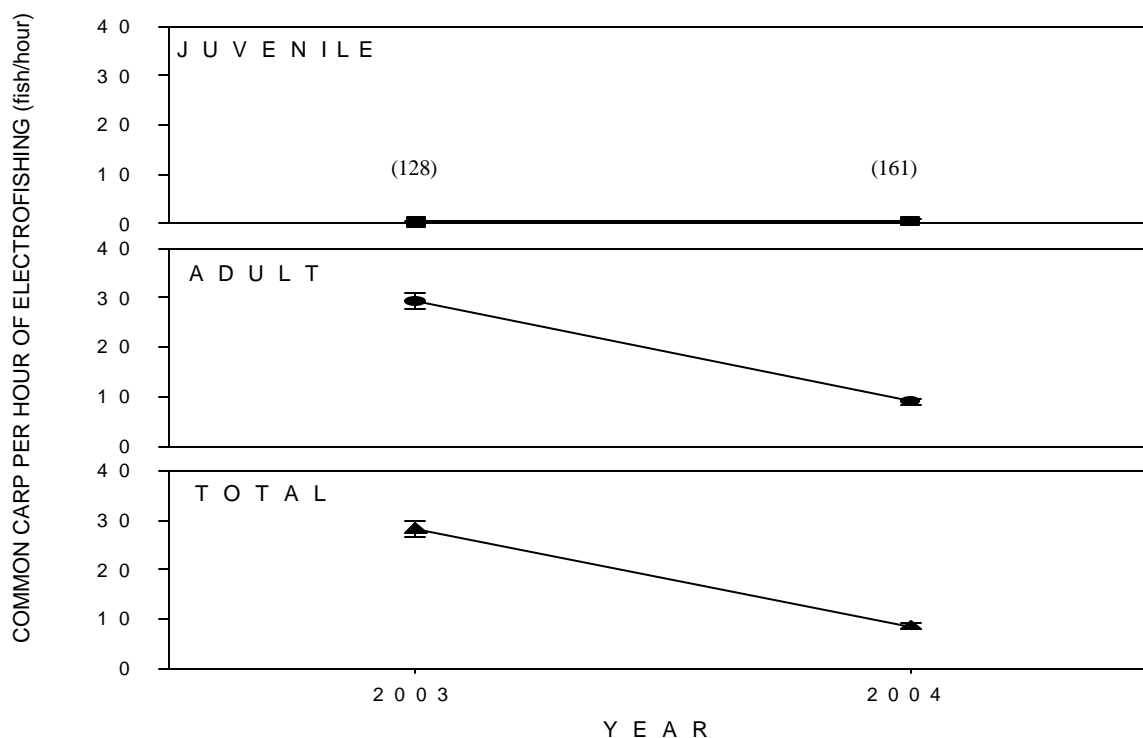


Figure 13. Common carp CPUE (fish/hour) by year within the Hogback Diversion to Shiprock Bridge Section. Sample size listed parenthetically and error bars represent ± 1 SE.

Comparisons between Sections 1 and 2

Channel catfish CPUE varied between Sections and among years with typically much higher CPUE below Hogback Diversion. Within Section 1 (PNM Weir to Hogback), channel catfish CPUE in 2004 ranged from 0.6 to 54.5 fish/hour. These CPUE, although high, are relatively low in comparison with Section 2 (Hogback to Shiprock) CPUE. Lowest channel catfish CPUE in Section 2, in 2004, was 25.4 fish/hour and ranged to 98.1 fish/hour. Six trip mean CPUE in Section 1 was 28.8 fish/hour compared to a four trip mean CPUE of 56.1 fish/hour in Section 2, nearly twice that observed in Section 1 ($p < 0.001$).

To compare seasonal differences in channel catfish and common carp abundance between Sections, intensive non-native removal trips were conducted in December 2003 and November 2004. On each trip, Sections 1 and 2 were sampled within four days of each other so that water conditions (i.e. discharge, temperature, water clarity) were essentially the same.

Channel catfish CPUE within Section 1 during 2003 was 0.6 compared to 39.3 fish/hour ($p < 0.001$) immediately downstream in Section 2. Similar trends were observed during 2004 with 0.6 fish/hour collected in Section 1 compared to 25.5 fish/hr in Section 2 ($p = 0.003$) (Figure 14). Common carp CPUE also varied between reaches and years with values in 2003 of 6.8 fish/hour within Section 1 and 38.4 fish/hour in Section 2 ($p < 0.001$). Significant differences did not occur ($p = 0.708$) in 2004 CPUE of 14.7 fish/hour within Section 1 and 12.9 fish/hour within Section 2.

Native Fish Response to Intensive Non-native removal

To help determine native fishes response to intensive non-native removal efforts, we analyzed catch rates of both flannemouth and bluehead suckers collected within removal reaches. Similar to non-native fishes analyses, sucker data were divided by life stages and mean CPUE was compared to determine trends.

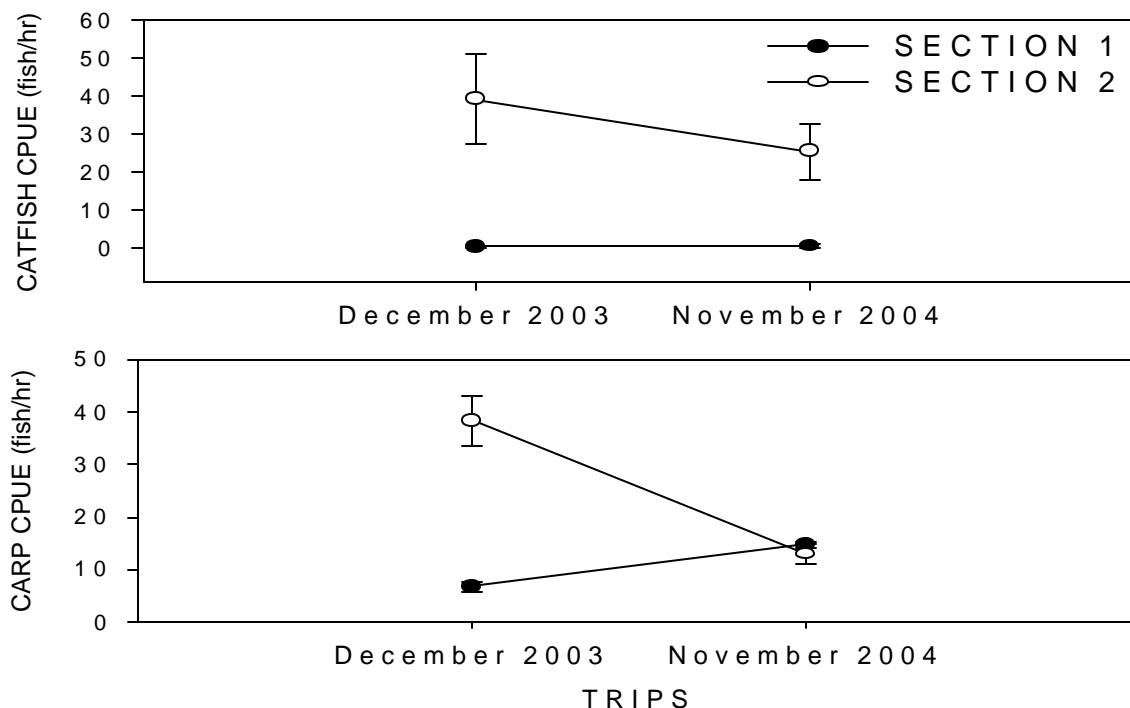


Figure 14. Comparison of channel catfish and common carp CPUE between two separate Sections where intensive non-native removal takes place (Section 1 = PNM Weir to Hogback Diversion; Section 2 = Hogback Diversion to Shiprock Bridge). Error bars represent ± 1 SE.

Flannemouth sucker CPUE within Section 1 (PNM Weir to Hogback Diversion) has changed little since 2001. Among 1999-2004 comparisons, flannemouth sucker CPUE has not significantly changed for individual size classes or for all life stages combined. Individual life stages exhibited increasing trends in 2004 but none of these increases were considered significant.

Bluehead sucker CPUE within Section 1 was similar to flannemouth sucker CPUE trends and have changed little since 2001. Among 1999-2004 comparisons, bluehead sucker CPUE has not significantly changed for individual size classes or for all life stages combined. Bluehead sucker CPUE exhibited a general decrease for individual size classes, with exception of young-of-year, between 2003-2004 but these changes were not significantly different.

Analysis of native sucker CPUE may have failed to detect significant changes due to the completion and operation of the Nenahezad Fish Passage located at RM 166.6. This selective fish ladder is at the upper portion of the intensive non-native removal study area and has been in operation since 2003. Since operations began, a total of 39,822 flannemouth and bluehead sucker have been moved upstream and out of the study area. Numbers of fish utilizing the fish passage show the importance of the passage itself in allowing fish to move upstream in presumably a similar way to what occurred prior to the barrier. However, the majority of native suckers utilized the fish passage prior to fall monitoring, and were may have been no longer available to electrofishing collections. This situation makes pre/post fish passage trend comparisons difficult to ascertain. In addition, flannemouth sucker CPUE significantly increased ($p = 0.004$) immediately upstream, RM 180.0 – 168.0, of the fish passage between 2003 and 2004. However, significant increases did not occur among other year comparisons. This increase may not be indicative of an overall increasing trend in flannemouth sucker abundance upstream of PNM Weir and may be resultant of sample variance among years.

Table 3. Total number of channel catfish and common carp and mean CPUE (fish/hour; parenthetically) collected during main channel electrofishing surveys conducted in the spring and fall of each year, 1998-2004.

| Species | Year | Young of Year | Juvenile | Adult | Total | Total Effort (Hours) |
|-----------------|---------------------------|---------------------|---------------------------|---------------------------|---------------|-------------------------|
| | | | | | | |
| Channel catfish | 1998 | 63 (.3) | 2,738 (11.3) | 1,994 (8.1) | 4,795 (19.6) | 241.78 |
| | 1999 | 114 (.7) | 2,798 (19.6) | 2,224 (13.5) | 5,136 (33.9) | 158.88 |
| | 2000 | 112 (.6) | 4,305 (23.5) | 1,907 (10.6) | 6,320 (34.7) | 178.06 |
| | 2001 | 110 (.4) | 4,435 (21.3) | 2,269 (12.0) | 6,814 (33.6) | 212.05 |
| | 2002 | 40 (.4) | 1,193 (9.0) | 1,166 (9.3) | 2,409 (18.7) | 243.45 |
| | 2003 | 52 (.4) | 774 (5.6) | 773 (6.4) | 1,599 (12.7) | 126.64 |
| | 2004 | 253 (2.1) | 1,387 (10.2) | 689 (4.2) | 2,329 (16.5) | 128.19 |
| | Total % of total catch | 744 (.6) [2.53%] | 17,630 (15.1) [59.96%] | 11,022 (9.3) [37.49%] | 29,402 (25.0) | 1,289.05 |
| Common carp | 1998 | 1 (<.0) | 51 (.2) | 3,308 (13.6) | 3,360 (13.8) | 235.12 |
| | 1999 | 0 (.0) | 13 (.1) | 3,075 (18.4) | 3,088 (18.5) | 158.88 |
| | 2000 | 99 (.6) | 235 (1.4) | 2,430 (14.1) | 2,764 (16.1) | 178.06 |
| | 2001 | 0 (.0) | 98 (.6) | 3,508 (15.4) | 3,606 (16.0) | 212.05 |
| | 2002 | 31 (.3) | 154 (1.5) | 1,082 (8.5) | 1,268 (10.3) | 235.90 |
| | 2003 | 3 (.2) | 52 (.4) | 757 (6.2) | 812 (6.6) | 126.64 |
| | 2004 | 29 (.3) | 191 (1.8) | 681 (4.6) | 901 (6.6) | 128.19 |
| | Total % of total catch | 163 (.2) [1.03%] | 794 (.8) [5.03%] | 14,841 (12.4) [93.94%] | 15,799 (13.3) | 1,289.05 |

Riverwide Removal Efforts (RM 180.0 – 0.00)

A total of 2,329 channel catfish and 901 common carp were opportunistically removed during monitoring trips in 128.19 hours of electrofishing (Table 3). Majority of channel catfish collected in 2004 were young-of-year or juvenile ($n = 1,640$; 70.42%). Number of adult channel catfish has decreased annually since 2001 with 689 adults removed in 2004 (Table 3). Common carp removed were primarily adult fish comprising 75.58% of total common carp catch. These numbers were similar to previous years but do represent the fewest number of adults in sampling conducted since 1998.

Channel catfish

Channel catfish CPUE for all Geomorphic Reaches and all life stages combined has varied since 1998 but generally exhibit a declining trend in abundance (Table 3, Figure 15). Catch rates increased in 2004 but remain significantly lower ($p < 0.001$) than values observed from 1999-2001 and are at levels similar to those observed in 1998. Increases in overall channel catfish CPUE are due in part to increased juvenile CPUE. Juvenile CPUE was similar to 1998 and 2002 values but remain significantly ($p < 0.001$) lower than values observed from 1999-2001. Adult channel catfish CPUE declined for the third consecutive year, although not significantly in 2003-2004 comparisons ($p = 0.17$), and are at the lowest levels in 1998-2004 comparisons (Figure 15).

Within Geomorphic Reach 6, portions of which intensive removal occurs, channel catfish CPUE for all life stages combined declined ($p = 0.04$) from 2003-2004 and were at the lowest values observed from 1998-2004 (Figure 16). Juvenile channel catfish CPUE has not seen declines in 1998-2004 comparisons Adult CPUE significantly ($p = 0.02$) declined since the highest CPUE was observed in 2001 and are at the lowest values observed among 1998-2004 comparisons.

Catch rates for all life stages combined within adjacent Geomorphic Reach 5 has declined ($p < 0.001$) since 2001 and are at the lowest levels observed among 1998-2004 comparisons (Figure 16). Juvenile channel catfish CPUE did not decrease while adult CPUE continued to decline ($p = 0.03$) in 2004. Adult CPUE has declined every year since 1999 to end with a mean CPUE of 7.9 fish/hour in 2004 compared to 28.2 fish/hour in 1999 (Figure 16).

All other Geomorphic Reaches had general increases in CPUE of channel catfish for all life stages combined (Figures 17 and 18). Observed increases in overall CPUE resulting from increases in juvenile CPUE were observed. No declining trends have been observed for adult channel catfish in Geomorphic Reaches 4-1.

Channel catfish mean total length (TL) for all Geomorphic Reaches combined declined from 301.8 mm in 2003 to 218.1 mm in 2004 ($p < 0.001$). This mean was the lowest among 1998-2004 comparisons and exhibit a decline for the first time since 1999 (Figure 19). Mean TL decreased in each of the six Geomorphic Reaches (Figure 20). Although a general decrease in mean TL occurred within in Geomorphic Reach 6, portions of which intensive removal occurs, the change was not significant ($p = 0.61$). A significant decrease ($p < 0.001$) occurred in adjacent Geomorphic Reach 5 but this decrease is resultant of the relatively small sample size ($n = 12$, of which 5 were < 100 mm) and should be interpreted carefully. Decreases ($p < 0.05$) occurred within Geomorphic Reaches 4 and 3 and declined for the second consecutive year. Additionally, means of 235.7 and 222.9 mm, respectively, are the lowest mean TL's in each Geomorphic Reach among 1998-2004 comparisons. Mean TL decreases as sampling moves downstream (Figure 20).

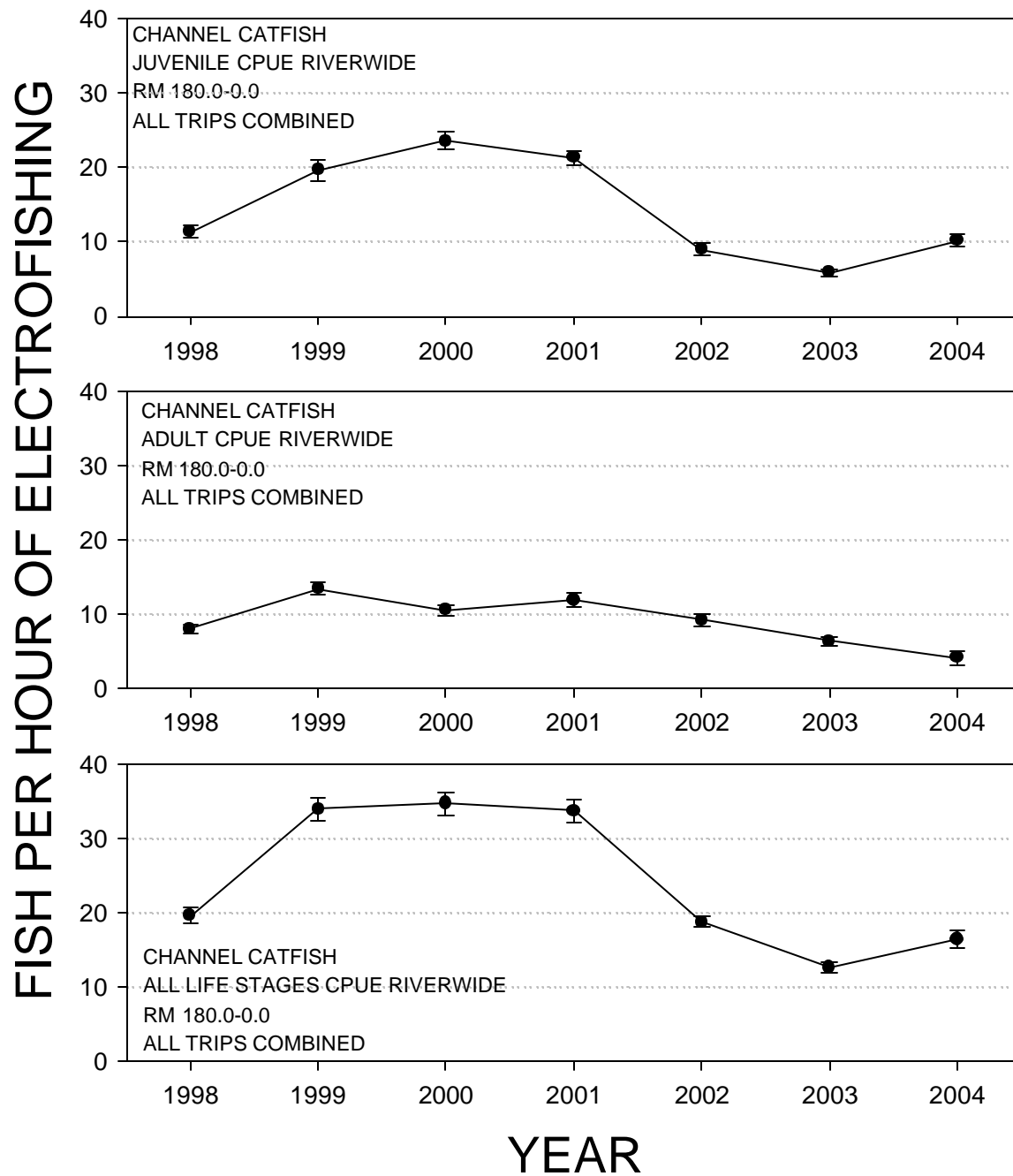


Figure 15 Channel catfish CPUE (fish/hour) by size class and by year, 1998-2004. Fish collected during riverwide monitoring efforts conducted by FWS-GJ in the spring and fall of each year. Error bars represent ± 1 SE.

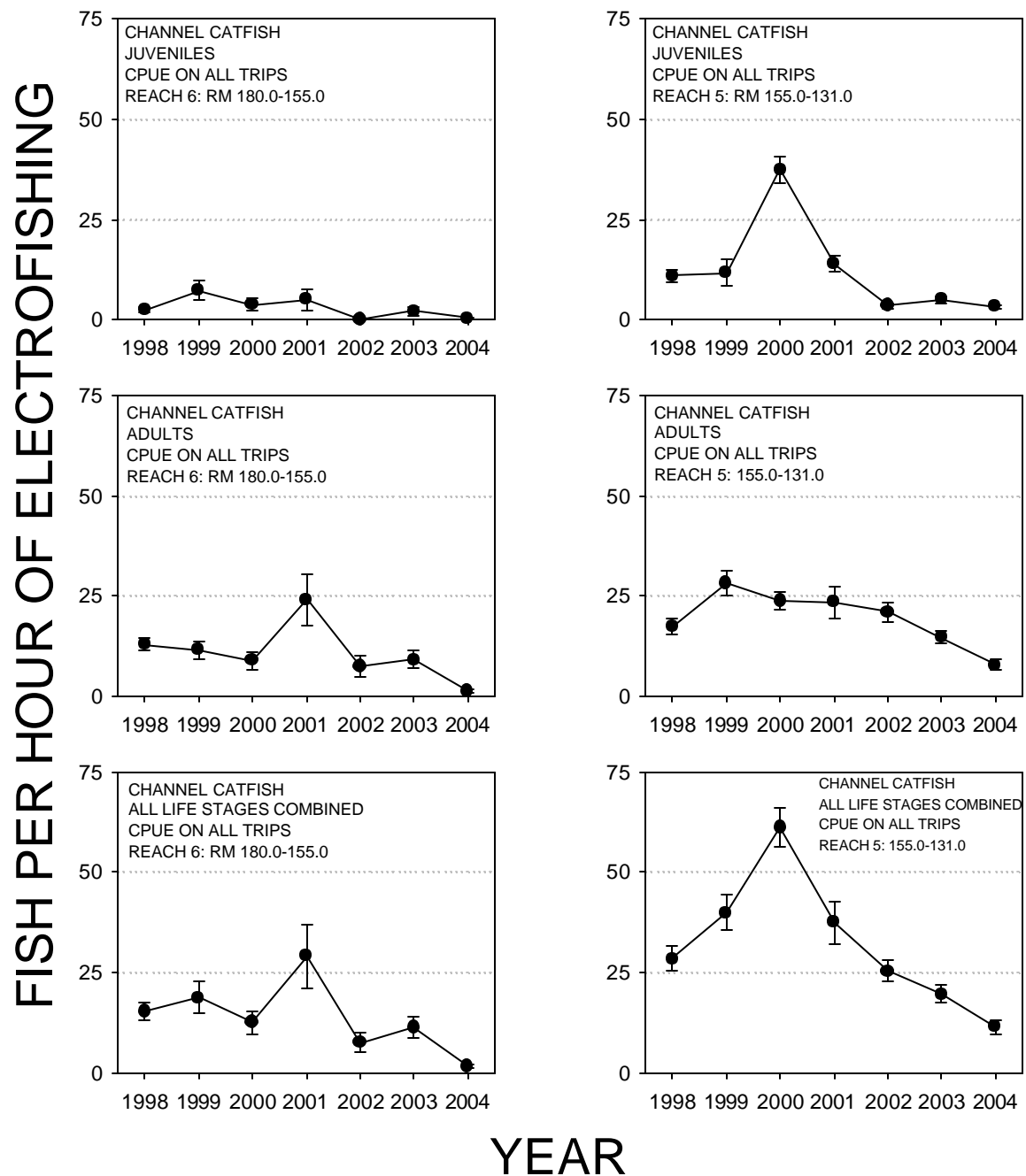


Figure 16. Channel catfish CPUE (fish/hour) in Geomorphic Reaches 6 and 5 by size class and by year, 1998-2004. Fish collected during riverwide monitoring efforts conducted by FWS-GJ in the spring and fall of each year. Error bars represent ± 1 SE.

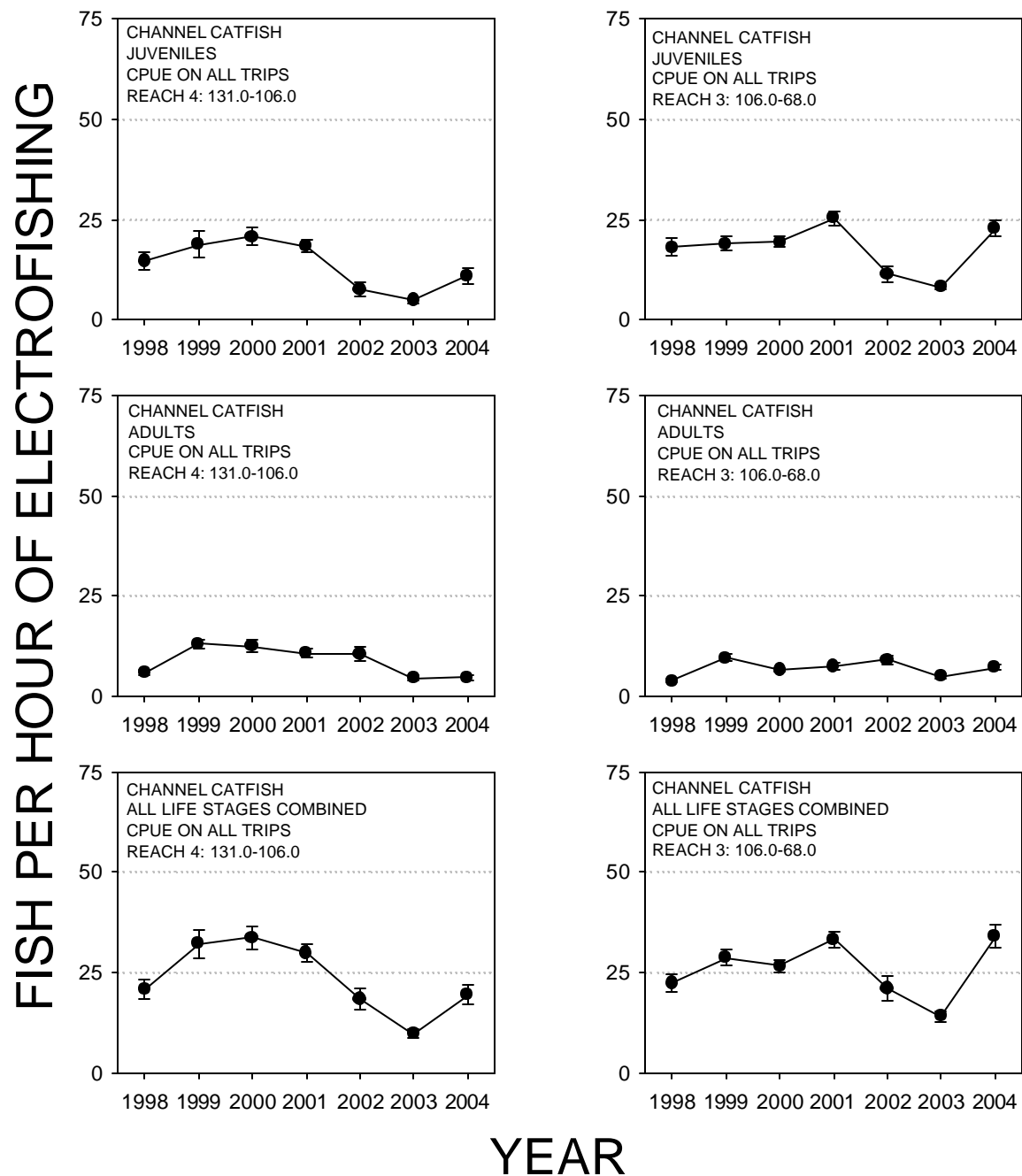


Figure 17. Channel catfish CPUE (fish/hour) in Geomorphic Reaches 4 and 3 by size class and by year, 1998-2004. Fish collected during riverwide monitoring efforts conducted by FWS-GJ in the spring and fall of each year. Error bars represent ± 1 SE.

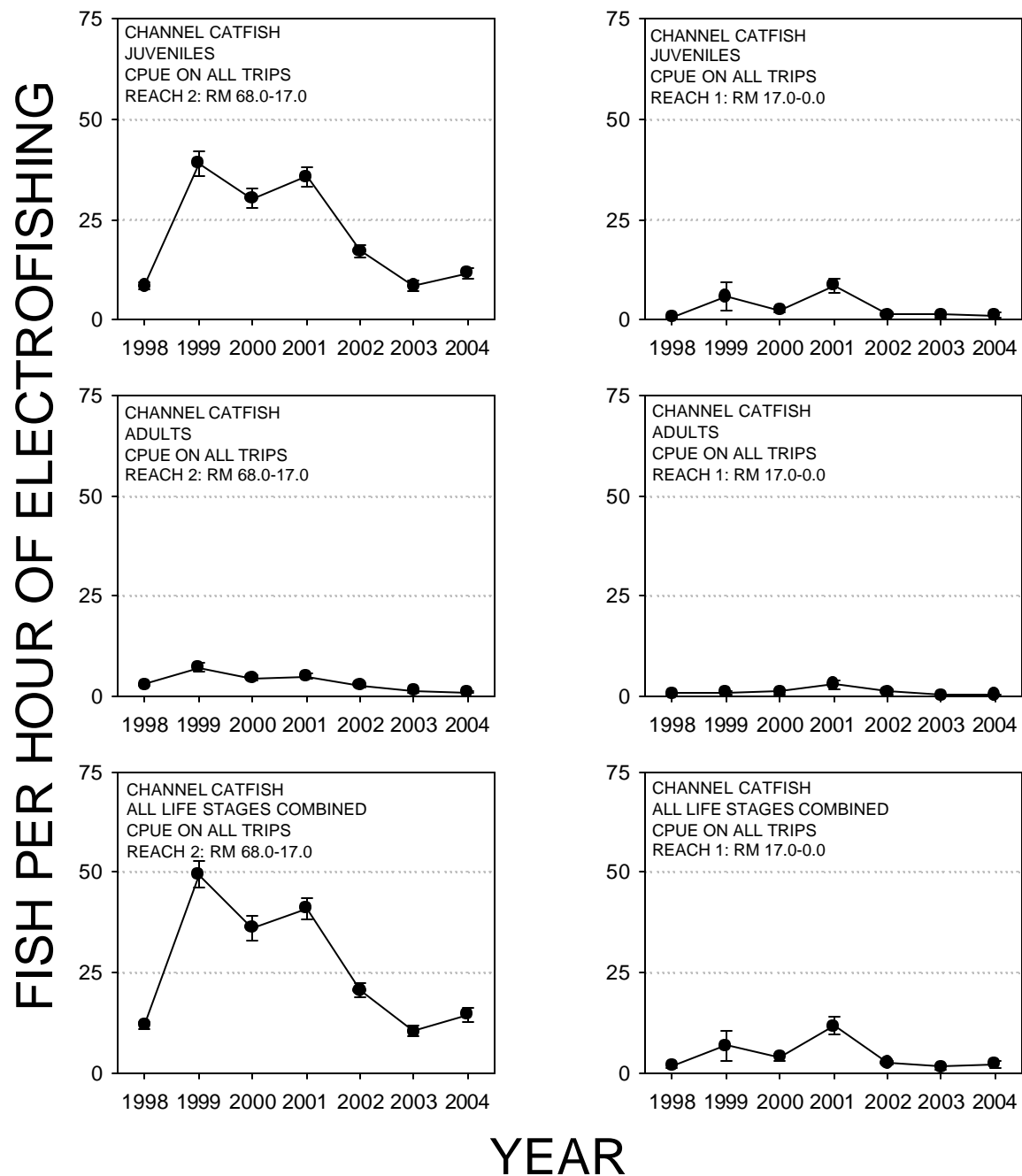


Figure 18. Channel catfish CPUE (fish/hour) in Geomorphic Reaches 2 and 1 by size class and by year, 1998-2004. Fish collected during riverwide monitoring efforts conducted by FWS-GJ in the spring and fall of each year. Error bars represent ± 1 SE.

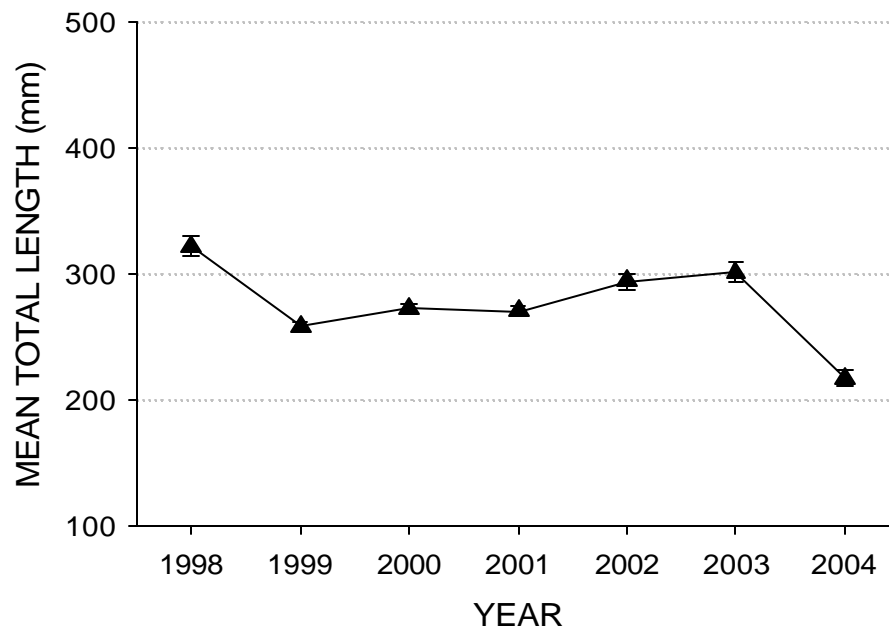


Figure 19. Mean total length (mm) of channel catfish collected in all Geomorphic Reaches during fall monitoring of each year 1998-2004. Error bars represent ± 1 SE

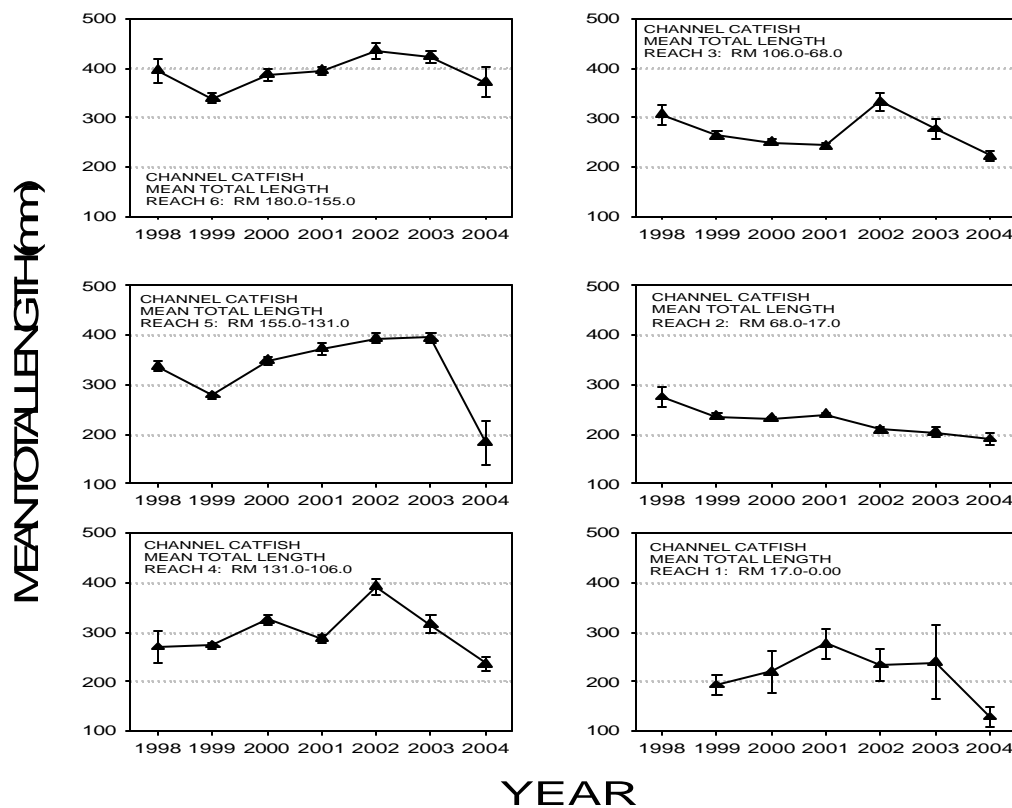


Figure 20. Mean total length (mm) of channel catfish by Geomorphic Reach and by year. Error bars represent ± 1 SE.

Common carp

Common carp CPUE for all Geomorphic Reaches and all life stages combined has varied since 1998 but generally exhibit a declining trend in abundance (Table 3, Figure 21). Catch rates have not changed since 2003 but remain lower ($p < 0.001$) than those observed in 2001. Catch rates in 2004 are the second lowest among 1998-2004 comparisons. Differences in common carp CPUE are resultant of changes in adult CPUE. Since 1998, adult CPUE declined ($p < 0.05$) each year with the exception of 2003-2004 ($p = 0.06$). Juvenile fish comprised 21% of the overall common carp catch at < 2 fish/hour (Figure 21). While adult CPUE was the lowest observed since 1998 (4.6 fish/hour), juvenile CPUE was the highest at 1.8 fish/hour.

Within Geomorphic Reach 6, portions of which intensive removal occurs, common carp CPUE for all life stages combined did not decline from 2003-2004. Although significant declines were not observed in 2004, CPUE values were the lowest (8.0 fish/hour) among 1998-2004 comparisons, $p < 0.001$ (Figure 22). Juvenile CPUE has not declined since 1998 and continue to comprise little of the overall common carp catch at 2.4 fish/hour. Adult CPUE did not decline in 2004, $p = 0.66$, but remains lower ($p = 0.001$) than values observed in 2001.

Catch rates for all life stages combined within adjacent Geomorphic Reach 5 did not decline in 2004 but remain lower ($p < 0.001$) than 2001 values (Figure 22). Juvenile CPUE has not changed since 1999 and continue to comprise a small percentage of the overall common carp catch in Geomorphic Reach 5. Adult CPUE of 10.0 fish/hour was similar to 2003 and was the lowest CPUE among 1998-2004 comparisons (Figure 22). No significant changes occurred for all life stages combined within Geomorphic Reaches 4-1 (Figures 23 and 24).

Common carp mean total length (TL) for all Geomorphic Reaches combined declined from 481.0 mm in 2003 to 360.8 in 2004 ($p < 0.001$). This is the lowest mean TL among 1998-2004 comparisons and is similar to the mean TL observed in 2000 (Figure 25). Similar to channel catfish, mean TL decreased in each of the six Geomorphic Reaches in 2004 (Figure 26). Although a general decrease in mean TL occurred within Geomorphic Reach 6, portions of which intensive removal occurs, the change was not significant ($p = 0.67$). Mean TL has not significantly declined for Geomorphic Reaches 3 and 1 and have not exhibited a declining trend among 1998-2004 comparisons. Mean TL in Geomorphic Reaches 5, 4, and 3 declined ($p < 0.05$) from 2003 and each are the lowest mean TL among 1998-2004 comparisons. Unlike channel catfish, mean TL does not decrease as sampling continues downstream. This hold true with the exception of Geomorphic Reach 6 which remains lower ($p < 0.05$) than all other Geomorphic Reaches.

Rare Fish Collections

A total of 28 Colorado pikeminnow recaptures (24 individual fish) was collected in Section 1 in 2004. Of the 28 recapture events, 7 (25.0% of catch) occurred between PNM Weir and APS Diversion. Colorado pikeminnow were 79 – 530 mm TL and included age-0 to age-9 fish. A total of 15 Colorado pikeminnow were previously PIT tagged and 8 lacked a PIT tag. Due to size restrictions, (< 150 mm TL) these were released without implanting. A total of 21 razorback sucker were collected in Section 1. All fish were unique captures and ranged 334 – 540 mm TL. All fish were recaptures with the exception of one individual. Due to the size of the fish (438 mm TL; 359 mm SL) it is likely that this was a stocked individual whose prior PIT tag was expelled or was no longer readable. Two razorback sucker (9.52% of recaptures) were recaptured above APS Diversion.

A total of 84 Colorado pikeminnow representing 75 individual fish was collected in Section 2 in 2004. Fish were 62 – 362 mm TL. A total of 30 fish were considered new captures and did not have a PIT tag at time of capture. A total of 203 razorback sucker representing 181 individuals were recaptured in Section 2 in 2004. Of these, four did not indicate the presence of a PIT tag at time of capture but size of individuals suggest that these fish were recaptures (or stocked) fish that either expelled their tag or the tag was not longer readable.

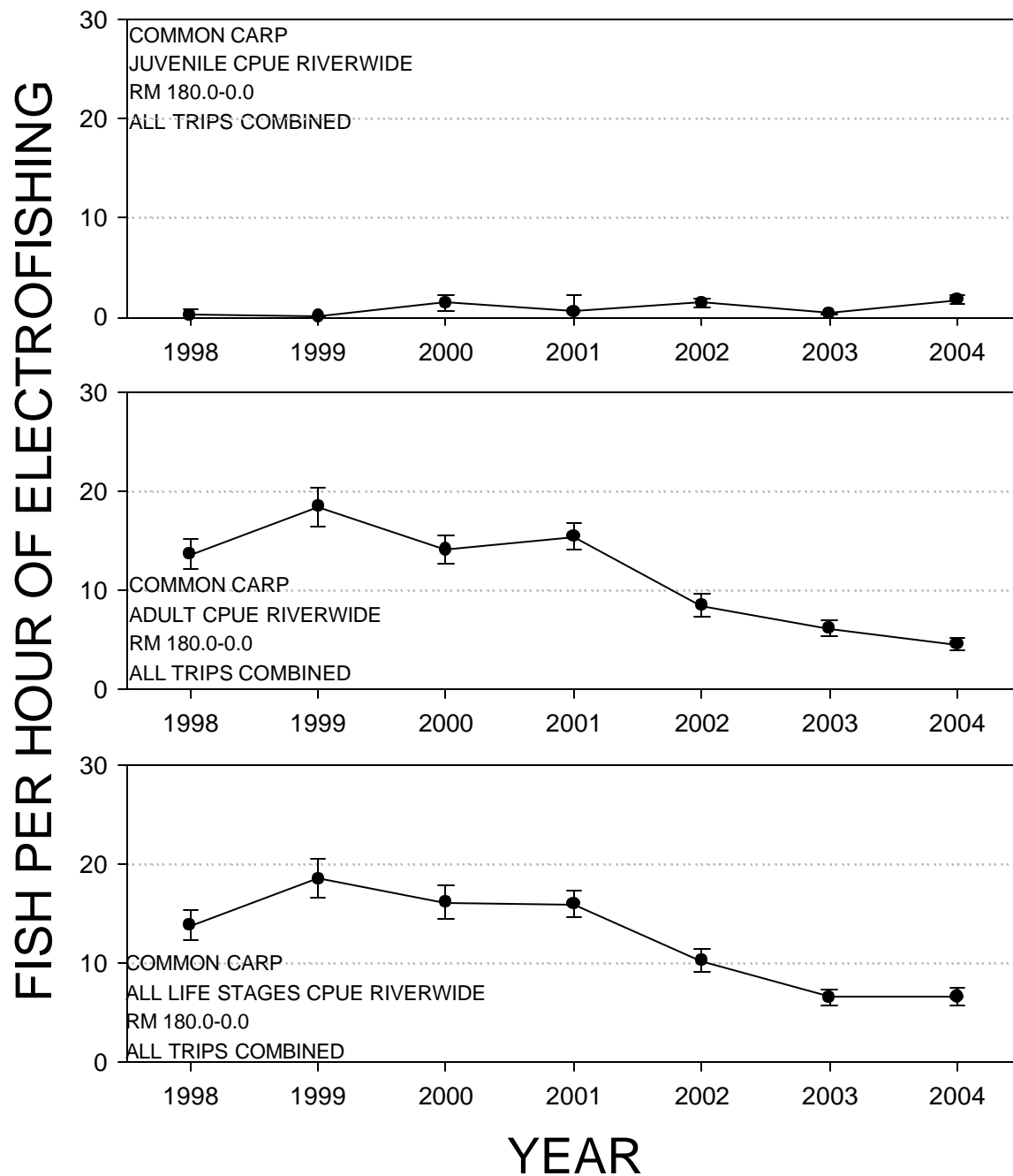


Figure 21. Common carp CPUE (fish/hour) by size class and by year, 1998-2004. Fish collected during riverwide monitoring efforts conducted by FWS-GJ in the spring and fall of each year. Error bars represent ± 1 SE.

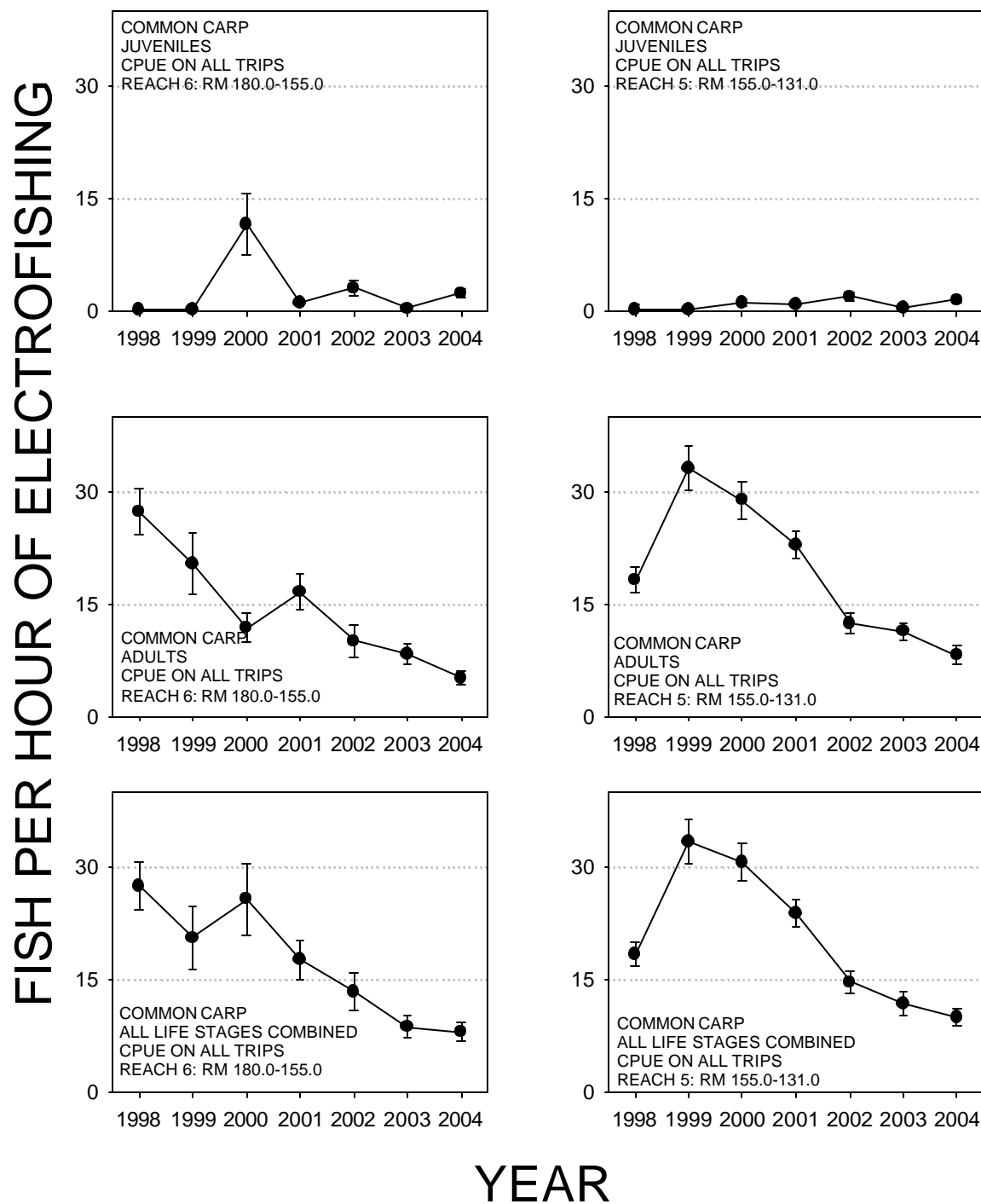


Figure 22. Common carp CPUE fish/hour in Geomorphic Reaches 6 and 5 by size class and by year, 1998-2004. Fish collected during riverwide monitoring efforts conducted by FWS-GJ in the spring and fall of each year. Error bars represent ± 1 SE.

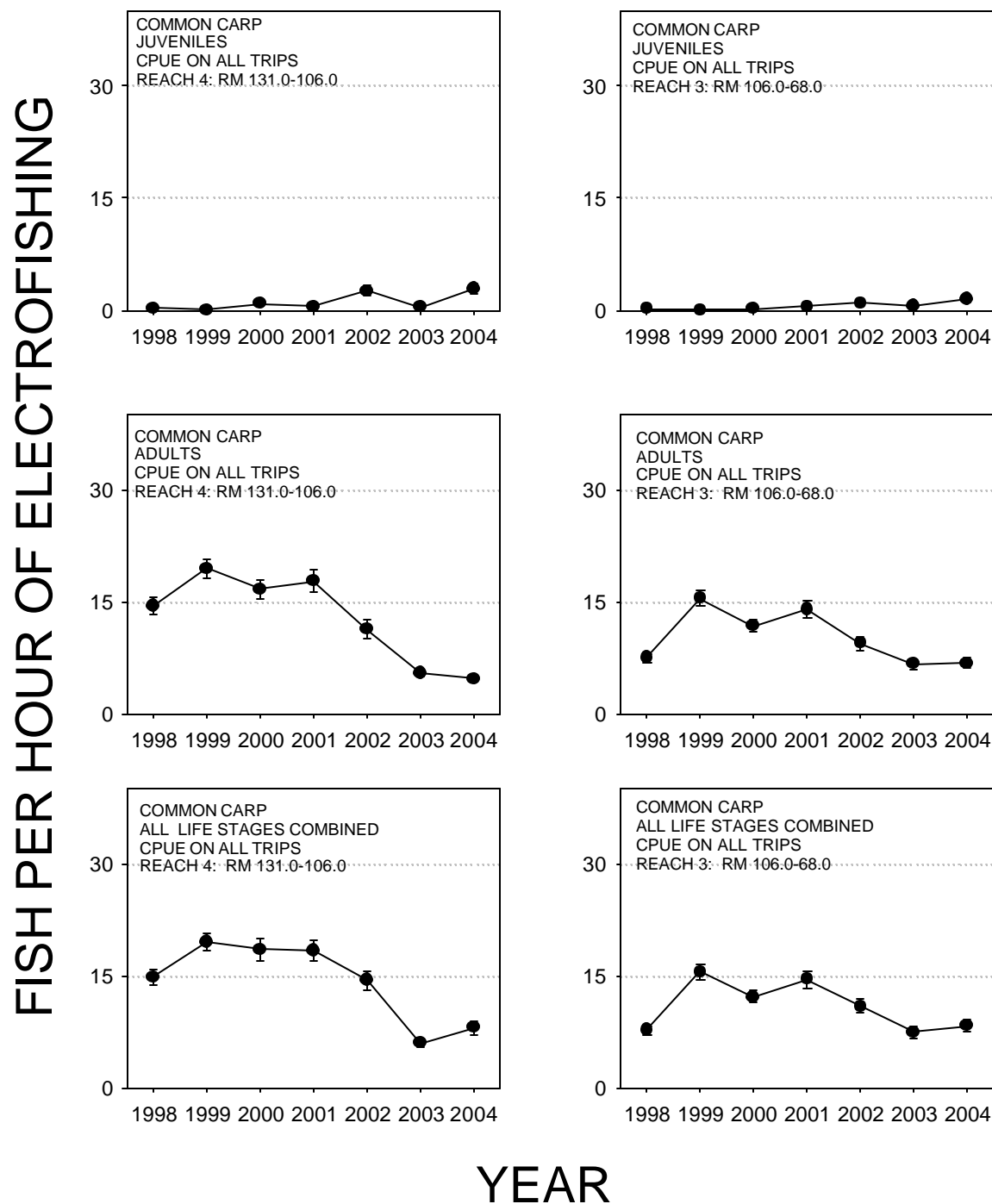


Figure 23. Common carp CPUE (fish/hour) in Geomorphic Reaches 4 and 3 by size class and by year, 1998-2004. Fish collected during riverwide monitoring efforts conducted by FWS-GJ in the spring and fall of each year. Error bars represent ± 1 SE.

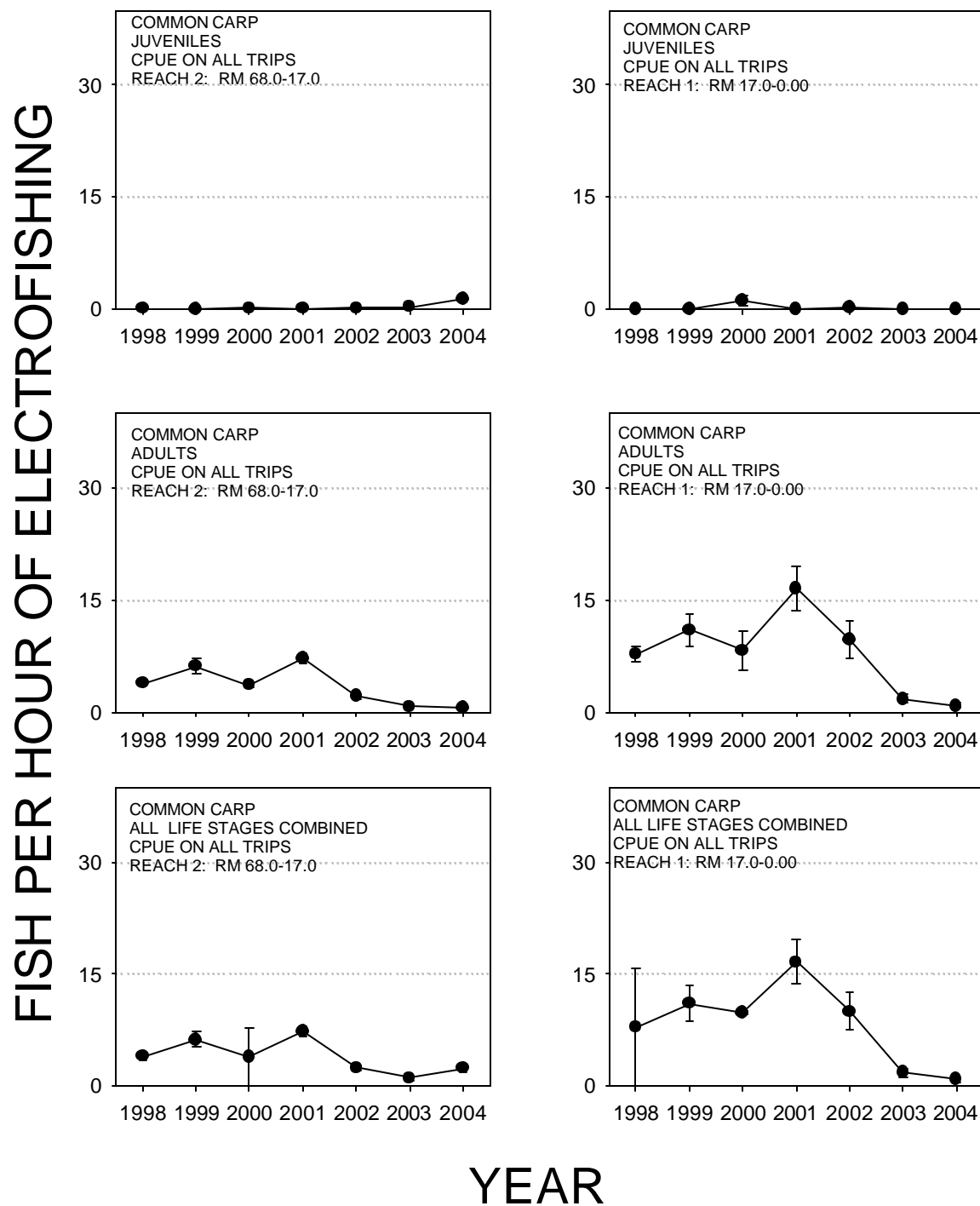


Figure 24. Common carp CPUE (fish/hour) in Geomorphologic Reaches 2 and 1 by size class and by year, 1998-2004. Fish collected during riverwide monitoring efforts conducted by FWS-GJ in the spring and fall of each year. Error bars represent ± 1 SE.

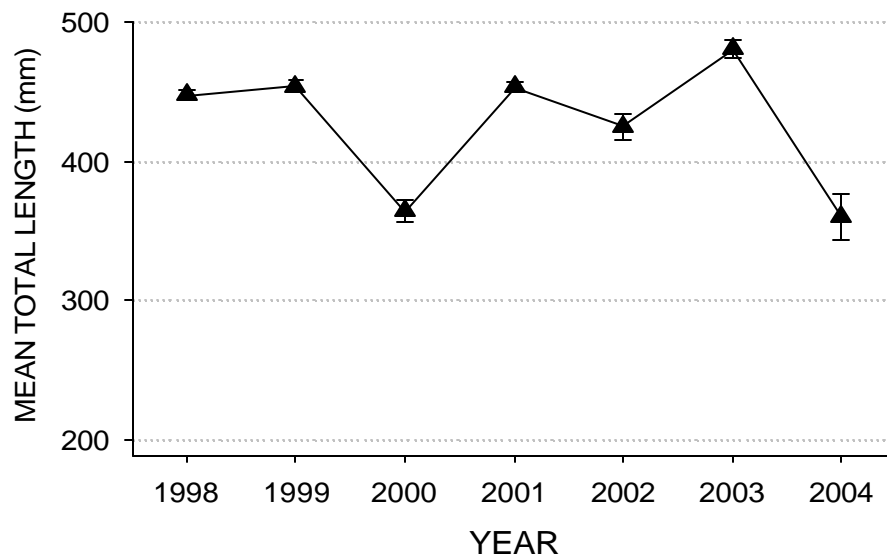


Figure 25. Mean total length (mm) of common carp collected in all Geomorphic Reaches during fall monitoring of each year 1998-2004. Error bars represent ± 1 SE

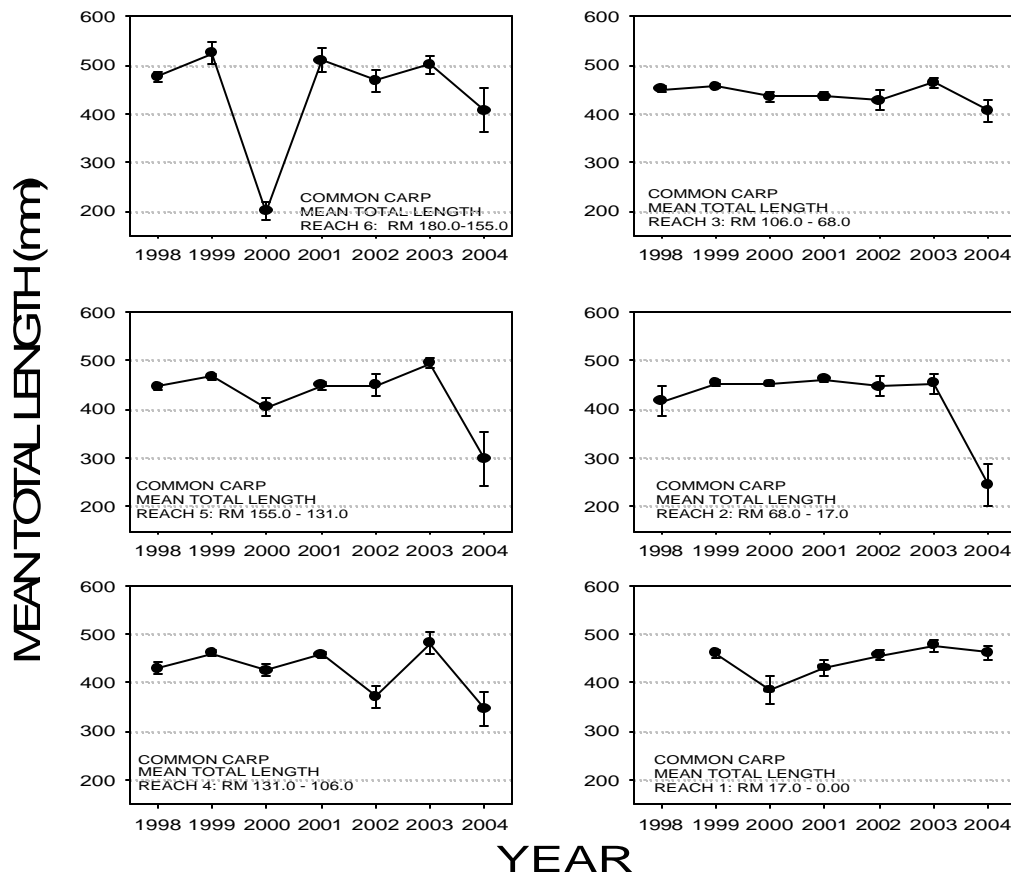


Figure 26. Mean total length (mm) of common carp by Geomorphic Reach and by year. Error bars represent ± 1 SE.

DISCUSSION

The majority of intensive non-native removal efforts were focused from PNM Weir to Hogback Diversion. However, due to seasonal variability in channel catfish CPUE, removal efforts were expanded in 2003 to include the Hogback Diversion to Shiprock Bridge Section.

Channel catfish CPUE from PNM Weir to Hogback Diversion (Section 1) has not declined among 2001-2004 comparisons. The lack of a clear decline in channel catfish CPUE is associated with increases in juvenile channel catfish CPUE. When non-native removal efforts first began, juvenile channel catfish were absent from collections within Section 1, while composing nearly 50% of the catch in 2004. Although CPUE for all life stages combined has remained similar since 2001 the shift to smaller fish is important

Declining trends in CPUE of large channel catfish and shift in size class distribution to smaller, less fecund size is encouraging. Shifts towards smaller fish may be important in long term suppression and reduction of channel catfish numbers in the San Juan River by reducing reproductive potential and recruitment. By removing large, more fecund channel catfish, mechanical removal has reduced numbers of sexually mature fish within intensive removal Sections. Helms (1975) found that 1 of 10 channel catfish were sexually mature at 330 mm TL, compared to 5 of 10 at 380 mm TL. In addition, it was determined that fish at 330 mm TL produced around 4,500 eggs/fish compared to the production of 41,500 eggs at 380 mm TL

A shift towards smaller channel catfish is also important for predation reasons. Brooks et al. (2000) found that San Juan River channel catfish < 300 mm TL consumed almost exclusively macroinvertebrates and Russian olive fruits with piscivory occurring most frequently in fish > 450 mm TL. Documentation of predation on endangered fish during their study was not observed due to the relatively low numbers of rare fish in the San Juan River at the time of their study, but has been documented elsewhere in SJRIP work (Jackson 2005). As augmentation efforts continue and numbers of rare fish increase, predation on rare fish by channel catfish will undoubtedly increase.

For example, in 2004 a 690 mm TL channel catfish collected by UDWR crews consumed a 325 mm TL razorback sucker, along with another 280 mm unidentifiable sucker in its stomach. These crews also documented a ~210 mm PIT tagged pikeminnow that was consumed by a 416 mm channel catfish (Jackson 2005). Aggressive behavior by channel catfish on native fishes has also been observed. Individual native suckers as large as 510 mm have been collected with apparent channel catfish bite marks across the dorsal region (Ryden, personnel communication; personal observations). Instances of predation and other negative interactions with native fishes may be reduced with continued shifts to smaller channel catfish. Food habits studies suggest channel catfish of this size are not piscivorous with gape limitations possibly preventing predation.

Common carp are ubiquitous and during 1991-1997 SJRIP studies were found to be the fourth most abundant fish in electrofishing collections (Ryden 2000). In addition to widespread abundance, majority of common carp collected were large adult fish > 400 mm TL, weighing up to or exceeding 1,800 grams. Within intensive removal reaches, total biomass of common carp removed has declined since 2001. It appears that removal efforts have been successful in decreasing common carp abundance, possibly limiting competitive interactions with native fishes and negative habitat modifications often associated with common carp (i.e. uprooting of aquatic plants causing increased turbidity, possible cause of noxious algae blooms by recycling of nutrients from silt substrates) (Cooper 1987). Although overall biomass of common carp has declined, average mass has increased since 2001 resulting in a higher mean condition factor $K_{(f)}$. It appears that common carp are becoming less common in collections but fish that are collected are generally larger, more robust fish than in previous years.

Seasonal variations in channel catfish and common carp CPUE may be attributed to sampling conditions, but most likely are due to localized movement patterns. Tagged non-native fishes have been documented to move upstream of Hogback Diversion and reoccupy Section 1 during summer months (Davis and Coleman 2004). In addition to this movement, CPUE between sub-sections of Section 1 (PNM Weir to Hogback Diversion) differ between each other. Both channel catfish and

common carp CPUE were significantly lower upstream of APS Diversion than downstream. Due to flow conditions and operational requirements of APS Diversion, it appears that upstream movement of non-native fishes was limited, but possible. Although this sub-section (PNM-APS) is not a true closed population, both mark/recapture data and intensive non-native removal CPUE data suggest that movement into this sub-reach has been limited. These data suggest that if given a true closed population, or a section of river where emigration is limited, mechanical removal by electrofishing can be successful in the San Juan River.

Largemouth bass collections in Section 1 during 2004 are interesting due to the relatively high number observed. However, pulses in juvenile largemouth bass CPUE have been observed in previous years with fish failing to recruit into adult size classes (Dale Ryden, personal communication). It is unknown where these fish originate from but it is unlikely that they are year round residents actively reproducing in the San Juan River. The San Juan River lacks quiet, warm waters with low turbidity preferred by largemouth bass (Pflieger 1997, Robison and Buchanan 1988). A more likely source would be from off channel ponds and associated irrigation returns that are common in this Section. The majority of largemouth bass collections in 2004 occurred at or nearby irrigation returns (Davis, personal observation). Concern about largemouth bass in the San Juan River and active mechanical removal efforts geared specifically towards this species does not need to be considered unless recruitment to adult size classes are observed.

Ascertaining native fishes response exclusively to mechanical removal efforts has proven to be difficult. Trends in native sucker distribution and abundance are dependant on multiple factors including discharge, temperature, habitat suitability and mechanical removal. Trends in native sucker CPUE from PNM Weir to Hogback Diversion show little change since 2001, when removal efforts began. Catch rates for native suckers in this Section may have been even higher before completion of the Nenaheza Fish Passage at RM 166.6. Since 2003, a total of 39,822 flannemouth and bluehead suckers have been processed and transferred upstream of our study reach (Lapahie 2003, 2004) and may have influenced CPUE trend comparison. Lack of apparent declines in native sucker abundance related to repeated exposure to electrofishing is encouraging. These data suggest that management tools and methodology like intensive non-native removal by electrofishing are not having deleterious affects on native fish abundance. Further research into the affects repeated exposure to electrofishing has on native fishes is encouraged.

Decreasing trends in both channel catfish and common carp CPUE riverwide continued to be observed and were at the second lowest levels among 1998-2004 comparisons. Adult channel catfish CPUE in 2004 was at the lowest level observed during riverwide monitoring since 1998. Juvenile channel catfish CPUE increased in 2004, but was still at levels lower than 2001 when intensive removal began. Large, more fecund channel catfish continued to comprise a small proportion of the catch. Mean TL of channel catfish in 2004 was the lowest observed since 1998.

Observed reductions in channel catfish CPUE since 1998 are likely a result of both intensive and opportunistic removal efforts conducted riverwide. However, other factors such as discharge, habitat quality and availability, and temperature may have influenced decreases as well. Decreased abundance riverwide is likely reducing potential negative interactions with native fish. Continued reduction in mean TL and shifts to smaller size class distributions of channel catfish are important indicators of successful removal and exploitation efforts. Results are similar to those Pitlo (1997) observed as evidence of overexploitation of channel catfish in the Mississippi River. It was observed that as the numbers of large fish decline, the population became highly dependent on newly recruited fish, resulting in large fluctuations in catch and dependence on the strength of individual year-classes. Shift towards smaller fish in the San Juan River with fewer large individuals results in a possible reduced reproductive potential and may influence recruitment in subsequent years.

Common carp abundance, based of CPUE, appears to have decreased since 1998 and is primarily a result of fewer large adult fish in electrofishing collections. With recent flow conditions in the San Juan River lacking out of bank flow, available low flow or slackwater, spawning and nursery habitats for common carp has likely been limited. Lack of available nursery habitat may

have influenced recent common carp abundance trends as much as mechanical removal has and close watch on trends post high spring discharge is necessary

Intensive non-native removal efforts by NMFRO continued to work with both state and tribal partners in transplanting channel catfish from the San Juan River to closed impoundments in the area. These efforts were initiated to address negative concerns by citizens about removal of game fish from the river. By transplanting channel catfish, anglers in the Four Corners region still have the opportunity of fishing for quality sized fish. To date, over 9,000 channel catfish have been transferred to closed impoundments with the assistance of Navajo Nation Department of Fish and Wildlife and New Mexico Department of Game and Fish. Fish transferred continue to be larger than those produced by federal and private hatcheries and average 356-406 mm TL and .31 fish/kg (14-16" and 0.68 fish/lb).

Intensive removal efforts will continue in 2005 with trips distributed between each of the two Sections. These data will continue to track changes in distribution and abundance trends and will help researchers in evaluating overall effectiveness of removal efforts. Important information on movement and retention of augmented rare fish will also be collected and will aid researchers in evaluation of augmentation efforts.

CONCLUSIONS

PNM Weir to Hogback Diversion (RM 166.6 – 159.0)

- Overall CPUE for channel catfish has not declined, 2001-2004 ($p = 0.894$).
- General declines of adult channel catfish and associated increases in juvenile CPUE ($p = 0.019$); typical of an over-harvested fish population.
- Juvenile channel catfish comprised $> 45\%$ of total catch in 2004 and were absent from collections in 2001. Channel catfish > 500 mm comprised $> 50\%$ of the catch in 1999 and only 3.5% in 2004
- Reductions in overall common carp CPUE have been observed 2001-2004 ($p < 0.001$).
- No apparent reduction in size class distribution of common carp.
- Increased CPUE of largemouth bass during August 2004 trip (15 fish/hr) and highest CPUE ($p = 0.033$) among 1998-2004 comparisons.

Hogback Diversion to Shiprock Bridge (RM 158.8 – 147.9)

- Overall CPUE for channel catfish has not declined, 2003-2004 ($p = 0.800$)
- Observed decreases ($p < 0.001$) in adult channel catfish and associated increases in juvenile CPUE ($p < 0.001$); typical of an over-harvested fish population.
- Mean TL and CPUE higher within this reach compared to the adjacent upstream reach.
- Reductions in overall common carp CPUE ($p < 0.001$) have been observed 2003-2004.
- No apparent reduction in size class distribution of common carp.

Riverwide Removal Efforts (RM 180.0 – 0.00)

- Channel catfish CPUE for all Geomorphic Reaches combined was slightly higher than 2003 but still lower than 1998 values.
- Third consecutive year of declining CPUE for adult channel catfish.
- Geomorphic Reaches 6 and 5, portions of which intensive non-native removal takes place, had the lowest channel catfish CPUE among 1998-2004 comparisons.
- Common carp CPUE for all Geomorphic Reaches combined was slightly higher than 2003 but still lower than 1998 values.
- Third consecutive year of declining CPUE for adult common carp and 2004 values was the lowest among 1998-2004 comparisons.
- Geomorphic Reaches 6 and 5, portions of which intensive non-native removal takes place, had the lowest common carp CPUE among 1998-2004 comparisons.
- Both channel catfish and common carp saw marked declines in average size with mean total lengths the lowest among 1998-2004 comparisons.
-

Channel catfish transplantation efforts 2001-2004

- Over 9,000 channel catfish have been removed from the San Juan River and transplanted to off channel reservoirs by the New Mexico Department of Game and Fish and the Navajo Nation Department of Fish and Wildlife.
- Transplanted San Juan River channel catfish were larger than fish provided by U.S. Fish and Wildlife Service National Fish Hatcheries.

Future removal efforts on the upper San Juan River

- Continue intensive removal efforts from RM 166.6 to 147.9.
- Expansion of removal trips to include at least two trips from Shiprock Bridge to Montezuma Creek, Utah (RM 147.9 – 93.6).

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APPENDIX

Appendix A. Colorado pikeminnow collected during intensive removal trips from PNM Weir to Hogback Diversion, 2004.

| Date | RM or Section | PIT tag | Recapture | Total Length (mm) | Standard Length (mm) | Weight (grams) | Comments |
|-----------|---------------|------------|-----------|-------------------|----------------------|----------------|--------------|
| 4/20/2004 | 163.4-159.0 | NO TAG | N | 137 | 117 | 15 | |
| | 163.4-159.0 | 5229795601 | Y | 189 | 157 | 44 | |
| 4/21/2004 | 163.4-159.0 | 7F7B1B0B31 | Y | 530 | 452 | 1250 | |
| 4/22/2004 | 163.4-159.0 | NO TAG | N | 132 | 111 | 16 | |
| 6/29/2004 | 163.4-159.0 | 441E2C7F17 | Y | 225 | 183 | 95 | |
| | 163.4-159.0 | 522A1E427F | N | 226 | 193 | -- | |
| | 166.6-163.4 | 522A2F6B76 | N* | 230 | 195 | 90 | |
| 6/30/2004 | 163.4-159.0 | 441E767F2A | Y | 251 | 206 | 125 | |
| | 166.6-163.4 | NO TAG | N | 79 | - | - | |
| 7/01/2004 | 163.4-159.0 | 141F1D621D | Y | 240 | 190 | 95 | |
| | 163.4-159.0 | 441E2F3341 | Y | 229 | 185 | 90 | |
| | 163.4-159.0 | NO TAG | N | 80 | 65 | - | |
| 7/20/2004 | 163.4-159.0 | 522A54130A | N | 224 | 184 | 60 | TAG NOT READ |
| | 166.6-163.4 | NO TAG | N | 230 | 186 | 82 | |
| 7/21/2004 | 166.6-163.4 | 7F7B1BOB31 | Y | 529 | 450 | 980 | |
| | 163.4-159.0 | NO TAG | N | 131 | 105 | - | |
| 7/22/2004 | 163.4-159.0 | 441C504C4B | Y | 280 | 220 | 155 | |
| 8/17/2004 | 163.4-159.0 | 441F1F7861 | Y | 283 | 229 | 168 | |
| | 166.6-163.4 | 512D5F2B33 | Y | 397 | 321 | 620 | |
| 8/18/2004 | 163.4-159.0 | 7F7B1BOB31 | Y | 530 | 450 | 1010 | |
| 8/19/2004 | 163.4-159.0 | 423C757921 | N | 165 | 133 | 38 | |
| | 163.4-159.0 | NO TAG | N | 135 | 115 | - | |

Appendix B. Razorback sucker collected during intensive removal trips from PNM Weir to Hogback Diversion, 2004.

| Date | RM or Section | PIT tag | Recapture | Total Length (mm) | Standard Length (mm) | Weight (grams) | Comments |
|------------|---------------|------------|-----------|-------------------|----------------------|----------------|----------|
| 3/23/2004 | 163.4-159.0 | 522A616543 | Y | 450 | 374 | 902 | |
| 3/24/2004 | 163.4-159.0 | 423E654D5D | N | 540 | 458 | 1950 | |
| 4/20/2004 | 163.4-159.0 | 5229193946 | N | 438 | 359 | 1850 | FEMALE |
| 4/20/2004 | 163.4-159.0 | 522A58157F | Y | 401 | 366 | 890 | |
| 6/29/2004 | 166.6-163.4 | 4240012C53 | Y | 445 | 374 | 1300 | |
| | 163.4-159.0 | 423F0F3B2F | Y | 457 | 393 | 1000 | |
| | 163.4-159.0 | 423E307573 | Y | 442 | 377 | 950 | |
| | 163.4-159.0 | 441D52671A | Y | 371 | 305 | 630 | |
| | 163.4-159.0 | 423E734C79 | Y | 450 | 370 | 1140 | |
| | 163.4-159.0 | 4419071C06 | Y | 355 | 294 | 540 | |
| | 163.4-159.0 | 441D530C25 | Y | 381 | 320 | 610 | |
| 6/30/2004 | 163.4-159.0 | 441B186760 | Y | 352 | 280 | 410 | |
| 7/01/2004 | 163.4-159.0 | 52283D0C7D | Y | 334 | 270 | 445 | |
| 7/20/2004 | 163.4-159.0 | 53244B047C | Y | 473 | 400 | 1800 | |
| | 163.4-159.0 | 44796E6D3E | Y | 382 | 320 | 560 | |
| | 163.4-159.0 | 5228710138 | Y | 452 | 381 | 850 | |
| 8/17/2004 | 163.4-159.0 | 4507082A1A | Y | 382 | 230 | 460 | LERNIA |
| 8/18/2004 | 166.6-163.4 | 441D5A7B6F | Y | 345 | 290 | 525 | |
| 8/18/2004 | 163.4-159.0 | 4473520A14 | Y | 390 | 340 | 780 | LERNIA |
| 11/08/2004 | 163.4-159.0 | 44152D1512 | Y | 377 | 305 | 795 | LERNIA |
| | 163.4-159.0 | 423E2A0977 | Y | 461 | 385 | 1400 | |

Appendix C. Colorado pikeminnow collected during intensive removal trips from Hogback Diversion to Shiprock Bridge, 2004.

| Date | RM | TL | SL | Wt | Recap | PIT tag |
|---------|-------|-----|-----|-----|-------|--------------|
| 5/11/04 | 155.0 | 172 | 139 | 35 | N | |
| 5/12/04 | 148.0 | 87 | 68 | N/A | N | |
| 5/13/04 | 151.0 | 62 | 53 | N/A | N | |
| 6/15/04 | 151.0 | 259 | 215 | 130 | Y | #441E617834 |
| | 152.0 | 209 | 170 | 64 | Y | #441E3F3C66 |
| | 152.0 | 220 | 178 | 80 | Y | #441E4A0352 |
| | 152.0 | 245 | 198 | 120 | Y | #441E6E0567 |
| | 154.0 | 210 | 160 | 75 | Y | #441E273538 |
| | 154.0 | 221 | 175 | 130 | Y | #441E3C6F05 |
| | 155.0 | 233 | 185 | 100 | Y | #441C29392F |
| | 155.0 | 220 | 175 | 82 | Y | #441E3C6F05 |
| | 155.0 | 225 | 180 | 90 | Y | #441F173C42 |
| | 156.0 | 247 | 190 | 120 | Y | #441F0A695F |
| | 157.0 | 210 | 168 | 53 | Y | #441E5F335B |
| | 149.0 | 223 | 170 | 85 | Y | #441E371474 |
| | 149.0 | 219 | 167 | 70 | Y | #441E4A0352 |
| | 149.0 | 222 | 173 | 80 | Y | #441E77577B |
| | 150.0 | 221 | 173 | 90 | Y | #441E371474 |
| | 150.0 | 218 | 175 | 70 | Y | #441E4A0352 |
| | 150.0 | 362 | 224 | 125 | Y | #441E617834 |
| | 150.0 | 239 | 198 | 75 | Y | #441F130B3E |
| | 151.0 | 208 | 166 | 75 | Y | #441E0B1E26 |
| | 151.0 | 248 | 205 | 105 | Y | #441E472530 |
| 6/16/04 | 152.0 | 185 | 147 | 50 | Y | #441E303B43 |
| | 152.0 | 75 | 59 | 5 | N | |
| | 152.0 | 260 | N/A | N/A | N | |
| | 153.0 | 212 | 170 | 75 | Y | #441E5A3D2B |
| | 154.0 | 194 | 161 | 60 | Y | #441E591E4C |
| | 154.0 | 212 | 170 | 72 | Y | #441E5A3D2B |
| | 154.0 | | | Y | | #441E6F004A |
| | 155.0 | 180 | 140 | 48 | N | #522A544139 |
| | 156.0 | 233 | 190 | 90 | Y | #441E5A7219 |
| | 156.0 | N/A | N/A | N/A | | |
| | 157.0 | 226 | 188 | 80 | Y | #441C660A0C |
| | 157.0 | 236 | 190 | 115 | Y | #441E610658 |
| | 150.0 | 233 | 195 | 90 | Y | #441F130B3E |
| | 150.0 | 250 | 207 | 115 | Y | #441F130D10 |
| | 151.0 | 232 | 190 | 80 | Y | #441E3C135 |
| | 151.0 | 246 | 203 | 110 | Y | #441E60567 |
| | 151.0 | 136 | 107 | N/A | N | |
| | 152.0 | 255 | 210 | 140 | Y | #441E2A1803 |
| | 154.0 | 234 | 190 | 100 | Y | #441E304973 |
| | 154.0 | 220 | 117 | 70 | Y | #441F113E1D |
| 6/17/04 | 154.0 | 213 | 170 | 65 | Y | #441F172E08 |
| | 155.0 | 232 | 185 | 90 | Y | #441D1144E01 |
| | 155.0 | 216 | 173 | 60 | Y | #441F113E1D |
| | | | | | | |

| | | | | | | |
|----------|-------|-----|-----|-----|---|-------------|
| | 155.0 | 214 | 170 | 60 | Y | #441F172E08 |
| | 156.0 | 244 | 190 | 110 | Y | #441E754B3E |
| | 156.0 | 235 | 192 | 95 | Y | #441F144E01 |
| | 157.0 | 243 | 195 | 105 | Y | #441F173E76 |
| | 157.0 | 76 | 61 | N/A | N | |
| 9/14/04 | 152.0 | 200 | 170 | 60 | N | |
| | 153.0 | 180 | 150 | 51 | N | |
| | 153.0 | 190 | 160 | 52 | N | |
| 9/14/04 | 155.0 | 175 | 140 | 42 | N | |
| | 156.0 | 174 | 142 | 40 | N | #42447E4716 |
| | 156.0 | 305 | 256 | 180 | Y | #441E3A651C |
| | 156.0 | 185 | 155 | 70 | N | #5229210072 |
| | 156.0 | 170 | 145 | N/A | N | |
| | 157.0 | 160 | 135 | 28 | N | |
| | 157.0 | 148 | 125 | 25 | N | |
| 9/15/04 | 151.0 | 151 | 124 | 30 | N | |
| | 152.0 | 182 | 150 | 54 | Y | #423C653568 |
| | 152.0 | 165 | 134 | 50 | Y | #424159116F |
| | 153.0 | 191 | 156 | 54 | N | #423D040E42 |
| | 153.0 | 185 | 155 | 50 | N | #42417C720D |
| | 153.0 | 181 | 136 | 37 | N | #42446A5843 |
| | 155.0 | 165 | 134 | 30 | N | #522A264F2C |
| | 155.0 | 190 | 156 | 51 | N | #522A2A2E2E |
| | 156.0 | 180 | 146 | 45 | N | #4244421A4E |
| | 156.0 | 175 | 147 | 31 | N | #52291A794C |
| | 157.0 | 177 | 144 | 50 | | #42400E193F |
| | 157.0 | 171 | 141 | 35 | N | #4242064E15 |
| | 157.0 | 205 | 171 | 70 | | #424470705A |
| | 157.0 | 158 | 122 | 32 | | #4244724806 |
| | 157.0 | 184 | 150 | 48 | | #42453B0465 |
| | 157.0 | 155 | 129 | N/A | N | #522A500556 |
| 11/16/04 | 148.8 | 85 | 64 | 4 | N | |
| | 154.5 | 162 | 133 | 32 | N | |
| | 157.0 | 149 | 120 | 22 | N | |
| | 157.0 | 162 | 130 | 32 | N | |
| 11/17/04 | 149.0 | 85 | 66 | 6 | N | |
| | 154.0 | 167 | 135 | 26 | N | |
| | 154.0 | 93 | 74 | 7 | N | |
| | 156.0 | 153 | 122 | 27 | N | |
| 11/18/04 | 149.0 | 162 | 131 | 27 | N | #4244453579 |

Appendix D. Colorado pikeminnow collected during intensive removal trips from PNM Weir to Hogback Diversion, 2004.

| | | | | | | |
|---------|-------|-----|-----|------|---|---------------|
| 5/11/04 | 151.0 | 378 | 328 | 610 | Y | #44210C7E33 |
| | 151.0 | 357 | 294 | 500 | Y | #5229711D7E |
| | 152.0 | 297 | 245 | 240 | Y | #441D4F161E |
| | 154.0 | 405 | 332 | 850 | Y | #44147B494B34 |
| | 154.0 | 433 | 367 | 750 | Y | #522A58157F |
| | 155.0 | 343 | 284 | 500 | Y | #44170D6809 |
| | 155.0 | 304 | 245 | 390 | Y | #441D4F161E |
| | 155.0 | 479 | 403 | 1450 | Y | #507E6B455A |
| | 155.0 | 351 | 286 | 450 | Y | #5228367538 |
| | 155.0 | 354 | 285 | 620 | Y | #52283A5C05 |
| | 155.0 | | | | N | |
| | 156.0 | 485 | 412 | 1450 | Y | #423F6A4379 |
| | 156.0 | 337 | 276 | 490 | Y | #441B052114 |
| | 156.0 | 321 | 270 | 550 | Y | #441B29707C |
| | 157.0 | 449 | 385 | 950 | Y | #4240017E60 |
| | 157.0 | 367 | 305 | 560 | Y | #441A794646 |
| | 157.0 | 370 | 311 | 615 | Y | #441D607075 |
| | 157.0 | 375 | 315 | 760 | Y | #5228371D10 |
| | 157.0 | 473 | 406 | 1300 | Y | #5324594E7C |
| 5/12/04 | 148.0 | 342 | 281 | 510 | N | #423D090D1A |
| | 148.0 | 452 | 384 | 1120 | Y | #424004437A |
| | 148.0 | 354 | 292 | 540 | Y | #5228367538 |
| | 149.0 | 315 | 260 | 440 | Y | #441D2E1F19 |
| | 150.0 | 437 | 356 | 950 | Y | #52283A1B71 |
| | 152.0 | 490 | 419 | 1000 | Y | #4242312966 |
| | 152.0 | 340 | 275 | 520 | Y | #5229763A0F |
| | 152.0 | 385 | 324 | 630 | Y | #522A505F23 |
| | 153.0 | 350 | 293 | 340 | Y | #4415291942 |
| | 153.0 | 410 | 349 | 500 | Y | #522860564A |
| | 154.0 | 450 | 385 | 990 | Y | #423F170161 |
| | 154.0 | 340 | 275 | 510 | Y | #5229763A0F |
| | 155.0 | 342 | 278 | 500 | Y | #44167F4930 |
| | 156.0 | 460 | 384 | 1055 | Y | #423F0D5520 |
| | 157.0 | 394 | 338 | 700 | Y | #522A575300 |
| 5/13/04 | 149.0 | 376 | 310 | 410 | Y | #5228446967 |
| | 151.0 | 460 | 393 | 980 | Y | #423F7E0831 |
| | 151.0 | 348 | 295 | 340 | Y | #5228453011 |
| | 152.0 | 447 | 360 | 820 | Y | #423C7A6305 |
| | 152.0 | 360 | 292 | 381 | Y | #441D282749 |
| | 152.0 | 381 | 317 | 470 | Y | #5229171632 |
| | 154.0 | 426 | 362 | 820 | N | #522A251013 |
| | 155.0 | 354 | 289 | 390 | Y | #441D59592B |
| | 155.0 | 337 | 272 | 320 | N | #52290B194E |
| | 156.0 | 435 | 370 | 775 | Y | #423F7E7469 |
| | 157.0 | 425 | 352 | 850 | Y | #423E5ED7C |
| | 157.0 | 459 | 380 | 675 | Y | #4240017E60 |

| | | | | | | |
|---------|-------|-----|-----|------|---|-------------|
| 6/15/04 | 151.0 | 376 | 312 | 540 | Y | #441D56076C |
| | 154.0 | 490 | 410 | 1000 | Y | #424015340B |
| | 154.0 | 462 | 295 | 500 | Y | #441B275D3C |
| | 154.0 | 441 | 360 | 920 | Y | #441E273538 |
| | 155.0 | 436 | 365 | 940 | Y | #423E714355 |
| | 155.0 | 442 | 355 | 800 | Y | #423F742F0F |
| | 155.0 | 458 | 375 | 820 | Y | #52283F3118 |
| | 156.0 | 338 | 274 | 450 | Y | #441D462F45 |
| | 157.0 | 457 | 381 | 850 | Y | #423F0D5520 |
| | 157.0 | 435 | 372 | 900 | Y | #423F7E7469 |
| 6/16/04 | 157.0 | 406 | 329 | 750 | Y | #522A575300 |
| | 150.0 | 375 | 308 | 530 | Y | #441D56076C |
| | 151.0 | 430 | 346 | 760 | Y | #423E7F419 |
| | 154.0 | 430 | 356 | 870 | Y | #423D1D0A77 |
| | 154.0 | 366 | 299 | 480 | Y | #441737015D |
| | 157.0 | 354 | 287 | 475 | Y | #441E610658 |
| | 157.0 | 355 | 287 | 480 | Y | #52282D173E |
| 6/17/04 | 157.0 | | | | | |
| | 151.0 | 435 | 365 | 1120 | Y | #423E717425 |
| | 153.0 | 477 | 380 | 1200 | Y | #4240105835 |
| | 154.0 | 431 | 362 | 810 | Y | #423C6E6151 |
| | 154.0 | 436 | 365 | 820 | Y | #4240166146 |
| | 154.0 | 425 | 350 | 825 | Y | #424218610D |
| | 154.0 | 363 | 302 | 470 | Y | #441737015D |
| | 155.0 | 453 | 375 | 1200 | Y | #53257A7764 |
| | 156.0 | 431 | 355 | 850 | Y | #423F7E7469 |
| | 157.0 | 444 | 367 | 775 | Y | #423F083F31 |
| 9/14/04 | 157.0 | 435 | 362 | 850 | Y | #423F7E7469 |
| | 151.0 | 450 | 390 | 810 | Y | #423E751E21 |
| | 152.0 | 385 | 330 | 550 | Y | #4364293F35 |
| | 155.0 | 345 | 295 | 430 | Y | #42415C1E3C |
| | 155.0 | 385 | 330 | 600 | Y | #43636C1451 |
| | 155.0 | 400 | 350 | 630 | Y | #45035D4D24 |
| | 155.0 | 409 | 340 | 690 | Y | #450950482F |
| | 155.0 | 445 | 375 | 910 | Y | #45127B2405 |
| | 156.0 | 482 | 412 | 1240 | Y | #4471571E1F |
| | 156.0 | 410 | 355 | 670 | Y | #4474193528 |
| | 156.0 | 375 | 305 | 555 | Y | #45063C3843 |
| | 156.0 | 385 | 320 | 610 | Y | #450711695B |
| | 156.0 | 412 | 347 | 690 | Y | #45073F2258 |
| | 156.0 | 363 | 303 | 620 | | #5229736141 |
| | 156.0 | 402 | 343 | 810 | | |
| | 157.0 | 479 | 395 | 1280 | Y | #423E761E52 |
| | 157.0 | 435 | 355 | 1000 | Y | #423F7E7469 |
| | 157.0 | 394 | 325 | 525 | Y | #434F016C0F |
| | 157.0 | 403 | 330 | 575 | Y | #43644B0226 |
| | 157.0 | 407 | 325 | 680 | Y | #43655D7910 |
| | 157.0 | 406 | 333 | 725 | Y | #4369053E68 |
| | 157.0 | 405 | 350 | 620 | Y | #4369256A62 |
| | 157.0 | 361 | 300 | 560 | Y | #4369332E06 |
| | 157.0 | 368 | 297 | 600 | Y | #44741B7F44 |

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|-----------|-------|-----|-----|------|---|-------------|
| 9/14/2004 | 157.0 | 396 | 323 | 600 | Y | #447A73677C |
| | 157.0 | 400 | 350 | 690 | Y | #447C2F1008 |
| | 157.0 | 372 | 303 | 480 | Y | #447C551F69 |
| | 157.0 | 370 | 315 | 520 | Y | #4502785577 |
| | 157.0 | 410 | 350 | 650 | Y | #4509032D12 |
| 9/15/04 | 152.0 | 493 | 419 | 1300 | Y | #43655A0319 |
| | 152.0 | 410 | 338 | 520 | Y | #43687D256E |
| | 152.0 | 390 | 318 | 640 | Y | #441D3C043D |
| | 152.0 | 407 | 348 | 820 | Y | #450B460B31 |
| | 153.0 | 405 | 330 | 610 | Y | #43687D256E |
| | 153.0 | 427 | 355 | 640 | Y | #44720F3D42 |
| | 155.0 | 383 | 330 | 570 | Y | #434F333745 |
| | 155.0 | 382 | 321 | 640 | Y | #4364495151 |
| | 155.0 | 394 | 330 | 740 | Y | #44747E3067 |
| | 155.0 | 415 | 355 | 800 | Y | #447E172339 |
| 9/15/04 | 155.0 | 378 | 321 | 460 | Y | #45032E3953 |
| | 155.0 | 422 | 360 | 890 | Y | #45065B5658 |
| | 155.0 | 345 | 290 | 310 | Y | #45071F2D04 |
| | 155.0 | 450 | 390 | N/A | Y | #4507492C41 |
| | 156.0 | 400 | 330 | 560 | Y | #434F201054 |
| | 156.0 | 425 | 350 | 725 | Y | #4365727573 |
| | 156.0 | 290 | 237 | 200 | Y | #43670F7F23 |
| | 156.0 | 345 | 278 | N/A | Y | #44172C7874 |
| | 156.0 | 395 | 335 | 580 | Y | #4472325150 |
| | 156.0 | 384 | 303 | 625 | Y | #4479714311 |
| | 156.0 | N/A | N/A | 830 | Y | #447B551F26 |
| | 156.0 | 411 | 340 | 575 | Y | #447E151E5C |
| | 156.0 | 377 | 320 | 410 | Y | #45065C4154 |
| | 156.0 | 425 | 364 | 790 | Y | #4507462116 |
| | 156.0 | 510 | 435 | 1510 | Y | #53245D7146 |
| | 157.0 | 375 | 315 | 390 | N | #4244555175 |
| | 157.0 | 360 | 306 | 380 | N | #42447B6965 |
| | 157.0 | 411 | 350 | 640 | Y | #434F110352 |
| | 157.0 | 285 | 241 | 225 | Y | #434F2C412B |
| | 157.0 | 415 | 355 | 750 | Y | #434F336E27 |
| | 157.0 | 356 | 305 | 400 | Y | #43653F1713 |
| | 157.0 | 400 | 335 | 610 | Y | #4365425C6E |
| | 157.0 | 422 | 360 | 800 | Y | #4365556268 |
| | 157.0 | 392 | 333 | 490 | Y | #436572173D |
| | 157.0 | 415 | 350 | 750 | Y | #43685E1C12 |
| | 157.0 | 340 | 284 | 360 | Y | #43685E435E |
| | 157.0 | 340 | 280 | 290 | Y | #43685E435E |
| | 157.0 | 384 | 332 | 540 | Y | #43692B686A |
| | 157.0 | 386 | 322 | 800 | Y | #441A734755 |
| | 157.0 | 378 | 321 | 560 | Y | #44711B0B62 |
| | 157.0 | 423 | 357 | 910 | Y | #44717D2D52 |
| | 157.0 | 402 | 340 | 670 | Y | #4473775C52 |
| | 157.0 | 372 | 319 | 500 | Y | #447910597F |
| | 157.0 | 404 | 348 | 760 | Y | #44795E557E |
| | 157.0 | 339 | 286 | 380 | Y | #45043D6827 |
| | 157.0 | 335 | 280 | 330 | Y | #4507112273 |
| | 157.0 | 320 | 264 | 340 | Y | #450A660976 |

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|----------|-------|-----|-----|------|---|--------------|
| 11/16/04 | 148.8 | 390 | 332 | 575 | Y | #43642C164B |
| | 148.8 | 416 | 358 | 860 | Y | #45065F4F4F |
| | 149.8 | 415 | 355 | 800 | Y | #4477184012 |
| | 149.8 | 410 | 340 | 750 | Y | #447B246144 |
| | 149.8 | 379 | 310 | 650 | Y | #447B570911 |
| | 149.8 | 466 | 382 | 1060 | Y | #4509273412 |
| | 153.0 | 385 | 325 | 480 | Y | #45065C4154 |
| | 154.5 | 509 | 415 | 1250 | Y | #423F625669 |
| | 154.5 | 457 | 366 | 950 | Y | #4240012C53 |
| | 154.5 | 462 | 380 | 1000 | Y | #42421B7D5C |
| | 154.5 | 486 | 397 | 1350 | Y | #44103C2024 |
| | 154.5 | 462 | 383 | 1080 | Y | #4467081E05 |
| | 154.5 | 377 | 302 | 600 | Y | #4473365138 |
| | 154.5 | 503 | 428 | 2100 | Y | #4479736824 |
| | 154.5 | 407 | 338 | 920 | Y | #4504223F69 |
| | 154.5 | 404 | 332 | 550 | Y | #45073B4400 |
| | 156.0 | 405 | 345 | 700 | Y | #4504223F69 |
| | 157.0 | 276 | 220 | 220 | Y | #4368795176 |
| 11/17/04 | 149.0 | 460 | 381 | 980 | Y | #423F746427 |
| | 149.0 | 395 | 327 | 500 | Y | #4364293F35 |
| | 149.0 | 400 | 330 | 600 | Y | #52290F1213 |
| 11/17/04 | 150.0 | 410 | 352 | 820 | Y | #4471201D6D |
| | 152.0 | 462 | 383 | 980 | Y | #423E751E21 |
| | 152.0 | 375 | 310 | 440 | | |
| | 154.0 | 425 | 352 | 800 | Y | #4240005A6D |
| | 154.0 | 415 | 352 | 800 | Y | #4369185754 |
| | 154.0 | 437 | 352 | 710 | Y | #43693F0C6A |
| | 154.0 | 395 | 330 | 740 | Y | #44737F1663E |
| | 154.0 | 476 | 390 | 1340 | Y | #507E6B455A |
| | 156.0 | 430 | 355 | 950 | N | #4249544B5F |
| | 156.0 | 399 | 330 | 610 | Y | #43654E782C |
| | 156.0 | 376 | 311 | 560 | Y | #4365702513 |
| | 156.0 | 420 | 351 | 705 | Y | #4368491D22 |
| | 156.0 | 399 | 328 | 890 | Y | #441A6D7833 |
| | 156.0 | 412 | 339 | 750 | Y | #44711E2606 |
| | 156.0 | 412 | 336 | 690 | Y | #4472004E79 |
| | 156.0 | 411 | 345 | 750 | Y | #4472443B29 |
| | 156.0 | 378 | 302 | 560 | Y | #4506603E3B |
| | 156.0 | 412 | 351 | 700 | Y | #450B127823 |
| | 156.0 | 430 | 359 | 960 | Y | #4519012410 |
| 11/18/04 | 156.0 | 394 | 326 | 620 | Y | #5229192938 |
| | 149.0 | 384 | 330 | 610 | Y | #447C300A40 |
| | 150.0 | 457 | 379 | 1300 | Y | #423E771339 |
| | 150.0 | 416 | 352 | 1000 | Y | #4471201D6D |
| | 150.0 | 378 | 305 | 660 | Y | #447C300A40 |
| | 152.0 | 423 | 355 | 700 | Y | #4369185754 |
| | 154.0 | 465 | 387 | 1320 | Y | #423F633E41 |
| | 154.0 | 409 | 344 | 810 | Y | #4364301266 |
| | 154.0 | 272 | 212 | 300 | Y | #436879517C |
| | 154.0 | 402 | 328 | 780 | Y | #4473403307 |
| | 154.0 | 470 | 400 | 1450 | Y | #44796B4E32 |

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|-------|-----|-----|------|---|-------------|
| 154.0 | 410 | 354 | 950 | Y | #447D3C1247 |
| 154.0 | 405 | 335 | 800 | Y | #450B16225A |
| 156.0 | 397 | 332 | 800 | Y | #434F307927 |
| 156.0 | 398 | 325 | 700 | Y | #4368550D6B |
| 156.0 | 280 | 231 | 230 | Y | #436879517C |
| 156.0 | 458 | 393 | 1400 | Y | #4502791865 |
| 156.0 | 350 | 288 | 625 | Y | #52283D0C7D |
| 156.0 | 479 | 408 | 1300 | Y | #522A47736F |